Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN

VOL. LVI. NEW YORK, THURSDAY, SEPTEMBER 8, 1910. No. 10.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK

JAMES H. MCGRAW, President.
HUGH M. WILSON, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITOR.....W. D. WEAVER
A. S. M'ALLISTER.....Associate Editor
W. H. ONKEN, JR.....Associate Editor
T. R. TALTAVALL.....Associate Editor
W. E. KEILY.....Associate Editor
O. A. KENYON.....Associate Editor
O. H. CALDWELL.....Assistant Editor
W. M. FINLEY.....News Editor
S. S. BOIES.....News Editor
FREDERIC NICHOLAS.....Special Contributor
J. R. CRAVATH.....Special Contributor

CHICAGO OFFICE.....1570 Old Colony Building
CLEVELAND OFFICE.....1015 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All Other Countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

Copyright, 1910, by MCGRAW PUBLISHING COMPANY.

Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1909 was 945,850. Of this issue, 17,250 copies are printed.

NEW YORK, THURSDAY, SEPTEMBER 8, 1910.

CONTENTS.

Editorial 547
Organization of the Electric Vehicle Association of America..... 550
President Taft on Water Powers..... 550
Convention of the New England National Electric Light Association 550
Complementary Operation of the Telephone and Telegraph in Chicago 551
Mexican Electrical Development..... 551
Telephone Service in the U. S..... 552
Evening Technical Course at Brooklyn Polytechnic..... 552
Report of Ontario Board on Municipal Accounting Methods..... 552
St. Lawrence-Long Sault Dam Project Halted..... 552
Stave Lake Hydroelectric Plant..... 553
Canadian Hydroelectric Commission News..... 553
New York Commission News..... 553
Maryland Commission News..... 553
Massachusetts Commission News..... 554
American Electrical Engineers.—XIII. By James A. Lighthipe.... 555
Current News and Notes..... 555
Central Station at Moline, Ill..... 557
A Recent Isolated Plant Installation for Country Residence Lighting. By W. D. Cassin..... 558
Wireless for a Transatlantic Airship. By F. M. Sammis..... 559
Prime-Movers at the Brussels Exposition. By Warren H. Miller.... 560
Single-Phase Commutator Motor. By Shiro Sano..... 561
A Network Problem. By Nicholas Stahl..... 565
Prizes for Suggestions for Improving Service..... 566
Maintenance of Meters in Small Plants..... 566
Demand and Diversity Factors and Their Influence on Rates. By J. R. Cravath..... 567
Lighting of Schools..... 570
Ornamental Street Lighting..... 572
New Telephone Patents..... 574
LETTER TO THE EDITOR:
Transmission Line Calculations. By John F. H. Douglas..... 575
Digest of Current Electrical Literature..... 575
Book Reviews..... 579
New Apparatus and Appliances..... 580
Industrial and Commercial News..... 584
General News..... 588
Weekly Record of Electrical Patents..... 593

THE WIRELESS SITUATION.

It is the usual fate of colossal inventions to pass through a wretched and ill-starred youth before winningg the place that is their due. Fate cannot block their progress, however, for any long period, nor deny to them ultimate greatness. Wireless communication is a case in point, in which the vicissitudes of early life have been even more strenuous than usual. A decade of technical success has brought it to no definite place in the commercial world, and has even left it with an evil odor of fraud hanging about it, that can be dispelled only by years of effort. It is only a few months since one wireless company cut down its capital stock to avoid drowning in its own pool, so to speak, and the officers and agents of another were indicted for reputed gross frauds in their desperate stock selling campaign. It is not too much to say that no important invention has ever been the victim of more reckless and culpable exploitation, or has made less commercial returns for a large expenditure of capital. It is surely a melancholy outcome for 10 years of persistent effort, and of real progress so far as scientific advances are concerned. But the important thing is not past misery, it is rather the chance of relief; and while it is never easy to forecast the future, it is absolutely safe to say that methods capable of sending messages even now over nearly a third of the world's girdle are foreordained in the fullness of time to play a great part in the world's work.

The long period of flamboyant exploitation must definitely end before this comes to pass. When wireless companies can definitely state their net earnings in hard cash, instead of counting them up in rainbow gold for payment at the Greek Kalends, the public will begin to have loyal and effective faith in them. The time is now here in which sane conservatism is necessary if the wireless business is to take the place that is its due; and lest we be misunderstood as doubting this place, we may without hesitation say that we believe it will be a very splendid one. It will be no long time before the words flashed out in New York or London will come echoing faintly back from the antipodes ere the finger that sent them has been lifted from the key, even as the quivers of an earthquake or the air waves from a tremendous eruption bear back and back again the story of their beginnings. Within a much less period there will be no spot on land or sea whence a call for help may not go up in case of need and be heard and answered. The first work to be done is to cover the ocean by a wireless network that will bring every sail within cry of land. At present in the great lanes of sea travel a liner is practically all the time within touch of port, but it is very generally only via one or more intervening ships, while in the breadths of the waters there are vast spaces where a ship could lose herself as completely as a caraval of five centuries ago.

Then there is besides very important commercial work to be done coastwise and on land, less startling and gigantic than the conquest of the oceans, but just as important and more re-

munerative. There is a wide field of public and private business over relatively short distances which is now almost untouched. The problem of tuning seems now to have been pretty well solved, at least for those cases in which great sending energy is not demanded. Hence there need be little interference in short-distance work, and there seems to be no good reason why wireless telegraphy, and for that matter telephony, should not be soon in quite regular and commonplace use wherever a wire connection may be inconvenient, or too costly. There will be a revolution worked in communication when one can, for example, sit quietly on his yacht or in his country house, and telephone his wandering friends likewise equipped, but that revolution is impending. The methods and apparatus of wireless communications are not perfect yet, but they are quite good enough for covering a field of work much greater and more varied than has been yet attempted. But the one thing necessary to secure this outcome is for the companies engaged in wireless work to quit fighting and abusing each other, to stop wasting time and money on merely sensational stunts, and to get down to hard work in the building and installation of commercial equipment. There is even now business enough within easy reach to give every legitimate wireless concern a fair show for a decent and profitable return on all the real money invested in it. There is a good chance for much greater things in the near future if we read the signs of progress aright, but it is time to quit fooling and to get down to hard work and solid business. The work of development is now in many and competent hands; the art is of great and demonstrated usefulness, and it only remains for it to recover from the present sorry situation. Wireless has been sowing its wild oats too long; it is time now for repentance and reform.

AN ELECTRICAL ASPECT OF THE RECENT CLOAKMAKERS' STRIKE.

On Sept. 2 the great strike of 70,000 garment workers in New York City terminated in an agreement signed by counsel on behalf of the disputants. This conflict between employers and employees lasted nine weeks, and is said to have rendered 70,000 workers idle, or to have involved a loss of more than 500,000 worker-weeks. But much more notable than the industrial loss, in this case, have been the issues involved. The issues have been of great sociological importance, particularly in relation to public health, public spirit, and the utilization of electric power in industry. It has long been notorious that in the distribution of labor on contract garment working in New York there have been many incidental abuses. Principal among these was the subcontracting, whereby work is let out to individuals at very low wages. The system of underbidding thus fostered led inevitably to the execution of this work, at its lowest levels, in dirty and unhealthy rooms, where disease germs could readily attach themselves to the garments, ready for subsequent communication to the future purchaser.

The avowed purpose of the strikers was not only for an abolition of the sweat-shop conditions, but also for a closed shop. The abuses of a closed-shop system are not the same as those of a sweat-shop system, but they may be equally great. To many of the workers, however, the exclusion of the one appeared to involve the existence of the other. Upon complaint of the employers over certain destructive disorders an injunction was secured from a New York State Supreme Court in which it was ruled that a strike called to demand the closed shop was illegal as being in restraint of trade. An agreement was finally reached on the "preferential union shop," a plan which seems to offer the best features of the closed shop to the exclusion of its worst features. How this will work out in practice remains to be seen. The principal clause, however, has been the abolition of sub-contracting within the shops, together with the establishment of sanitary, arbitration and grievance boards. If these provisions can be maintained, sweat-shops will disappear.

A prominent clause in the agreement was that of "free electric power" in the shops. This is a question of great importance and perhaps is the strategic key of the situation. It recalls the history of many another industry in which engineering has revolutionized conditions. Thus, in knitting, weaving, spinning, etc., the work was originally carried on at the artisan's home, either by hand, or by hand-driven tools. With the advent of steam power, hand workers could no longer compete with factory workers using large power machines. In each case home work ceased and was replaced by organized industry in a factory grouped around a power nucleus. Garment working has been one of the last industries to be evicted from the living-room of the artisan. The development of electrically-driven sewing machines in factories has, however, made the home work increasingly difficult and unremunerative, so that it has only needed a severe industrial disturbance, such as has recently transpired, to give a quietus to the miserable remains of competition between home work and factory work. The result is a distinct advance for society at large, and a step forward for electrical power distribution. The garment workers, as a class, will be promoted and benefited, although many competitors for admission into its ranks, who formerly secured a miserable connection with it, will be forced out into competition in other activities.

THE CONSTANTS OF CABLES.

In the solution of problems relating to the electrostatic capacity and self-inductance of concentric cables, it is desirable to keep in mind that the capacity of the cable considered as a condenser is directly proportional to the conductance of the dielectric, while the inductance is proportional directly to the resistance of the dielectric. It is evident, therefore, that from a knowledge of the resistance of the dielectric one can readily calculate both the inductance and the capacity. The formulas for expressing the resistance of the dielectric of a concentric cable are quite simple, but when an eccentricity exists, the modified formulas become very complicated. In an article in these columns (Aug. 25) Mr. Mayo Dyer Hersey described a simple approximate method for calculating the resistance which gives fairly accurate results when the eccentricity does not exceed certain limiting proportions. The method described is interesting not only on account of the results obtained, but even more so by reason of the reversal by the author of the usual scheme for deriving approximate formulas. Instead of obtaining initially the accurate complicated formulas and then discarding certain elements as being of "higher order" and therefore, of minor importance, the author assumes initially the existence of certain physical relations which are only approximately true, and

derives exact simple formulas for expressing their relations. In the case chosen, the method used is well justified because the results obtained differ inappreciably from the true results, and the exact error can readily be determined and allowed for. However, as a general method of solving complex problems, danger lies in applying any scheme involving the assumption of relations which do not exist. One is very apt to lose sight of the limitations and thereby obtain solutions which have no direct bearing upon the true conditions. Only in cases where the errors can easily be determined should a person use the general method of deriving approximate equations as described by the author.

ELECTROMAGNETIC MASS.

The queston, "Does the mass of a body vary with its speed?" forms, in substance, the subject of an article which appeared a few months ago in the *Revue Générale des Sciences.* A reply to this question, in the negative, has more recently been published (*Engineering,* June 11) by Prof. V. Dwelshauvers-Dery. It may be of interest to our readers to learn of this discussion, and know of the views on the subject, without attempting to enter into the matter very deeply. Since the days of Newton, mechanical science has recognized the properties of inertia and of mass in all bodies. This property may be described and defined in two statements: First, a body is powerless to alter its velocity in the absence of impressed moving forces; and, second, a free body accelerates in the direction of, and in proportion to, any impressed moving force, no matter what its existing velocity may be, or the number and direction of simultaneously impressed moving forces. The first of the above two principles may be defined as the principle of inertia in matter, since it means that everybody is inert so far as concerns the power of originating motion. The second principle may be defined as the principle of acceleration and of mass, because it deals with the amount of acceleration that an impressed force will produce in a body. The principle of inertia, and the principle of constant mass, have satisfactorily explained the phenomena of moving bodies from Newton's time down to the present day, within the limits of observational precision, whether the moving body was a falling apple, or whether it was a revolving planet. The origin of mass, or why a given force produced a definite acceleration in a body, has not been known; but whatever the nature of mass might be there was no good reason to suspect that it differed with the velocity of the body. In recent times, however, physicists have brought to light some remarkable facts concerning the motion of electrified bodies.

A moving electrified body has the local properties of an electric current, and the strength of the equivalent current is the product of the electric charge and of the linear velocity. Electrical workers are familiar with the facts that the magnetic energy of an electric current varies as the square of the current, and that a current possesses inertia of self-induction, or will not change unless work is done and electromotive force applied. Applying these facts to the case of the moving electrified body, the magnetic energy of this body will vary as the square of its velocity, and the body must possess an inertia of self-inductance whereby it will not change speed unless work is done and force applied to it. There can be no doubt that a moving electrified body has electromagnetic inertia, and has electromagnetic mass, owing to its electrification. Moreover, there can be no doubt that this electromagnetic inertia and mass obey, broadly speaking, the Newtonian laws of mechanical inertia and mass. But the amount of electromagnetic inertia that a body, say, a charged pith-ball, can possess by reason of the most powerful electric charge that can practically be given to it is so small by comparison with the mechanical mass of the pith-ball that it is not in the same class. The proposition of a minute extra mass in a charged body due to its charge remained then a mere insignificant detail of speculative interest, until recent experiments pointed to the possibility of the sub-division of the atom of matter into numerous much smaller entities called corpuscles, all inherently electrically charged.

The corpuscular hypothesis of matter is not yet accepted beyond the provisional stage. If, however, we assume the corpuscular hypothesis, then it appears to follow of necessity that the electromagnetic mass of a body, instead of being a very minute quantity, present or not according as the body was charged or discharged, is always present inherently, and is large enough to account for all of the mechanically observed mass. In other words, if we accept the electric corpuscular theory of matter, we seem practically compelled to banish the existence of the hitherto unexplained mechanical mass of matter, and to substitute therefor the compulsory existence of electromagnetic inertia. A material particle absolutely at rest, on this theory, has abundant electricity but no magnetic field. A movement of the particle sets up both a current and a magnetic field. This requires work and force application. During uniform motion, the magnetic field is steady around the moving particle. Stopping the particle releases the energy in this magnetic field. The adoption of the electric corpuscular theory of matter thus turns mechanical mass out of the doors of thought, and brings in electromagnetic mass, which becomes explained in terms of magnetism and electricity, but, as yet, no further.

The Newtonian principle of inertia is quite satisfied on the electromagnetic theory, but, strange to say, the principle of constant mass is not satisfied beyond a first approximation. It has been demonstrated that according to known electromagnetic laws, the mass of a body on the electromagnetic theory would be constant, for all practical purposes, at ordinary velocities; but that at very great velocities, the mass would increase, and that at the velocity of light, the mass would be infinite; so that if a body possessed this great velocity it would not accelerate under a force directed along its velocity, although it would accelerate under a force directed across its path. Consequently, the acceleration of such a body would not be in line with the resultant of a number of simultaneously applied forces. This proposition would only be very nearly true at low speeds. It is not yet possible to decide on experimental grounds between the old Newtonian theory of constant mass and the new theory of variable electromagnetic mass, because the velocity has to be so very great before any appreciable quantitative difference is involved between them. While to the engineer the question is of no practical importance, to the physicist the question is of great importance. Unfortunately for these, it is hard to experiment with bodies moving at or near the velocity of light.

Organization of the Electric Vehicle Association of America.

Duly incorporated under the laws of the State of New York the Electric Vehicle Association of America was formally organized at a meeting held in the office of Mr. Arthur Williams, of the New York Edison Company, on Thursday, Sept. 1. An account of the preliminary meeting at which the organization of the Electric Vehicle Association of America was discussed appeared in our issue of June 16. The object of the association is to promote the adoption and use of electric vehicles for business and pleasure purposes. Three classes of membership are provided: active, associate and honorary, and the by-laws provide for branches in centers of local activity. At the meeting on Sept. 1 the constitution and by-laws prepared by a committee appointed at the preliminary meeting were adopted and officers elected as follows: President, Mr. William H. Blood, Jr., of Stone & Webster, Boston, Mass.; vice-president, Mr. Arthur Williams, New York Edison Company, New York; treasurer and assistant secretary, Mr. Harvey Robinson, New York Edison Company, New York; secretary, M. C. E. Firestone, Columbus Buggy Company, Columbus, Ohio. The board of directors is composed of the following: Messrs. H. H. Rice, Waverley Company, Indianapolis, Ind.; F. W. Smith, United Electric Light & Power Company, New York City; P. D. Wagoner, General Vehicle Company, Long Island City, N. Y.; Louis Burr, Woods Motor Vehicle Company, Chicago, Ill.; F. L. Dyer, Edison Storage Battery Company, Orange, N. J.; J. T. Hutchings, Rochester Railway & Light Company, Rochester, N. Y.; Louis Ferguson, Commonwealth Edison Company, Chicago, Ill.; W. W. Freeman, Edison Electric Illuminating Company, Brooklyn, N. Y.; F. M. Tait, Dayton Lighting Company, Dayton, Ohio; H. Eames, Studebaker Brothers Company, New York, and C. Blizard, Electric Storage Battery Company, Philadelphia, Pa.

Convention of New England, N. E. L. A. Section.

Final arrangements have been completed for the forthcoming summer convention of the New England Section of the National Electric Light Association at the Griswold, New London, Conn., on Sept. 13 and 14. Secretary L. D. Gibbs states that a large registration has already been recorded, and it is anticipated that from 250 to 300 persons will attend the gathering. Elaborate plans have been made for the entertainment of the ladies, including various boat trips to the adjacent United States fortifications, sailing and motor boating, tennis, golf and bridge. Mr. C. H. Hodskinson is master of transportation for the New England section. Four papers will be presented, the topics being as follows:

The Advantages of a Uniform System of Rate Making, by Mr. Howard Corning, Bangor Railway & Electric Company, Bangor, Maine. *Illuminated Advertising—Its Possibilities,* by Mr. L. D. Gibbs, Edison Electric Illuminating Company, Boston. *Special and Decorative Street Lighting,* by Mr. J. A. Hunnewell, Lowell Electric Light Corporation, Lowell, Mass. *Opportunities,* by Mr. Levin J. Chase, Concord Electric Company, Concord, N. H.

Most of the delegations from Boston and northern New England points will go to New London on a special train leaving the South Station, Boston, on Monday, Sept. 12, at 3 p. m. Upon arrival at New London a special boat will be run to the Griswold. Mr. Alex. J. Campbell, of the New London Gas & Electric Company, is president of the New England section.

President Taft on Water Powers.

In a prepared speech before the Conservation Congress at St. Paul, Minn., Sept. 5, President Taft, speaking of the difficult question of saving the water-power sites, said:

"The subject is one that calls for new legislation. . . . It is the plain duty of the Government to see to it that in the utilization and development of all this immense amount of water-power, conditions shall be imposed that will prevent monopoly, and will prevent extortional charges, which are the accompaniment of monopoly. The difficulty of adjusting the matter is accentuated by the relation of the power sites to the water, the fall and flow of which create the power. . . .

"Serious difficulties are anticipated by some in such an attempt on the part of the General Government, because of the sovereign control of the state over the water-power in its natural condition, and the mere proprietorship of the Government in the riparian lands. It is contended that through its mere proprietary right in the site the central Government has no power to attempt to exercise police jurisdiction with reference to how the water-power in a river owned and controlled by the state shall be used, and that it is a violation of the state's rights. I question the validity of this objection. The Government may impose any conditions that it chooses in its lease of its own property, even though it may have the same purpose, and in effect accomplish just what the state would accomplish by the exercise of its sovereignty. There are also (and the Director of the Geological Survey, Mr. Smith, who has given a great deal of attention to this matter, is one of them) who insist that this matter of transmuting water power into electricity, which can be conveyed all over the country and across state lines, is a matter that ought to be retained by the General Government, and that it should avail itself of the ownership of these power sites for the very purpose of co-ordinating in one general plan the power generated from these Government-owned sites.

"On the other hand, it is contended that it would relieve a complicated situation if the control of the water-power site and the control of the water were vested in the same sovereignty and ownership, viz., the states, and then were disposed of for development to private lessees under the restrictions needed to preserve the interests of the public from the extortions and abuses of monopoly. Therefore, bills have been introduced in Congress providing that whenever the state authorities deem a water power useful they may apply to the Government of the United States for a grant to the state of the adjacent land for a water-power site, and that this grant from the Federal Government to the state shall contain a condition that the state shall never part with the title to the water-power site or the water-power, but shall lease it only for a term of years not exceeding fifty, with provisions in the lease by which the rental and the rates for which the power is furnished to the public shall be readjusted at periods less than the term of the lease, say every 10 years. The argument is urged against this disposition of power sites that legislators and state authorities are more subject to corporate influence and control than would be the central Government; in reply it is claimed that a readjustment of the terms of leasehold every 10 years would secure to the public and the state just and equitable terms.

"Then it is said that the state authorities are better able to understand the local need and what is a fair adjustment in the particular locality than would be the authorities at Washington. It has been argued that after the Federal Government parts with title to a power site it cannot control the action of the state in fulfilling the conditions of the deed, to which it is answered that in the grant from the Government there may be easily inserted a condition specifying the terms upon which the state may part with the temporary control of the water-power sites, and, indeed, the water power, and providing for a forfeiture of the title to the water-power sites in case the condition is not performed; and giving to the President, in case of such violation of conditions, the power to declare forfeiture and to direct proceedings to restore the central Government to the ownership of the power sites, with all the improvements thereon, and that these conditions may be promptly enforced and the land and plants forfeited to the General Government by suit of the United States against the state, which is permissible under the Constitution.

"I do not express an opinion upon the controversy thus made or a preference as to the two methods of treating water-power sites. I shall submit the matter to Congress and urge that one or the other of the two plans be adopted."

Complementary Operation of the Telephone and Telegraph in Chicago.

One naturally thinks of the electrical transmission of messages on a commercial scale as by either the telephone or the telegraph, but the Western Union Telegraph Company, by the great enlargement of its telephone service during the last year, seems to be demonstrating the fact that it is by the combination of telephone and telegraph that the greatest efficacy in message transmission may be found. For many years a comparatively small number of telegrams have been delivered by telephone and have been sent to telegraph offices in the same way, but by the present combination it seems to be made clear that every telephone may be made the terminus of a telegraph line. From it a message may be telephoned to the telegraph office and sent to any part of the world, and an answer received in the same manner. Where conversation is desired, of course the telephone alone continues to be used, either for short or long distances, but where a short message is involved, the telephone is made the first link in the chain, or possibly the first link and the last link, and the telegraph does the rest.

To carry this modern system into effect in Chicago, the Western Union Telegraph Company has established a rather elaborate telephone department in its main office in that city. This department is placed in a gallery at one end of the main operating room, and is cut off from the noise of the telegraph instruments by a sound-proof partition. Here there is a private branch exchange with a two-position switchboard containing 30 incoming trunk lines and connected with the exchange system of the Chicago Telephone Company. The ordinary telephone business of the various departments of the telegraph company is conducted in the ordinary manner through this switchboard, which is also connected directly with the branch offices in the downtown business district within a radius of half a mile from the main office.

For handling telegrams, however, special arrangements have been made. In the telephone room are two recording tables, each with positions for 10 telephone operators who sit five on a side facing each other. In front of each operator is a miniature lamp signal system, multiplied throughout, so that any incoming call flashes a white light to all operators, while a red lamp shows that any particular outgoing line is in use. All incoming calls pass through the switchboard, and if the call is for general office business the switchboard operator makes the desired connection. If the call is to send a telegram, the operator connects with the recording tables. Instantly a white signal is flashed at each of the 20 positions, and the first free operator plugs in. This action extinguishes the other lights, so that all operators know that the call is answered and the message is being taken. The accompanying picture shows the two-position switchboard and the recording tables, although some of the operators' positions at the latter are not occupied.

For the delivery of telegrams by telephone there are 15 outgoing lines running directly from the recording tables to the telephone company's exchange. This provision obviates congestion of the switchboard and provides an equipment capable of receiving a total of 20 messages and delivering 15 at the same time. While the number of messages delivered by telephone is greatly in excess of those received in that way, the incoming equipment must be large, because an average of three messages can be delivered by telephone in the time consumed in receiving one.

In the telephone department of the Chicago Western Union office there are about 20 employees, the department being in charge of a trained woman supervisor. The switchboard operators do nothing but make connections, while the operators at the recording tables receive and deliver telegrams only. An effort is made to concentrate the receipt and delivery of telegrams by telephone in the main Western Union offices in Chicago; that is, the public is being instructed to telephone its messages there instead of to the nearest branch office when there is no toll charge involved.

Telephone Room in Main Chicago Telegraph Office.

All telegraph messages addressed to Chicago received in the main operating room go directly from the wire to the distributing table in the city lines department, where they are routed to a branch-office wire and dropped to the messenger delivery department; or a telephone number is written on the message and it is sent immediately by automatic carrier to the telephone room. The search for telephone numbers is made at the distributing table, so that the telephone operators are not delayed. Thousands of messages received daily are immediately telephoned to the person addressed, and later, on request, may be delivered by messenger. Thus the slowest link in the chain of telegraphing—that is, the messenger boy—is eliminated from the transaction to a large extent.

Mexican Electrical Development.

The Mexico Tramways Company, the Canadian concern which owns the great hydroelectric plant at Necaxa and the extensive system of electric railways in Mexico City and the federal district, has just been granted concessions by the federal government for the construction of two electric interurban lines. One of these proposed roads is to run between Mexico

and Puebla, a distance of 129 miles, and the other between Mexico and Toluca, 32 miles. These two lines will be the longest electric railways in Mexico. It is stated that the construction of these two lines will involve some heavy and costly work. They will penetrate a region that is famous for its mountain beauty, and the Mexico City-Puebla road will pass between the volcanoes of Popocatepetl and Ixtaccihualt. The concessions require the roads to be finished within 10 years. The construction work will be started in a short time and the two lines will be finished in less than three years, it is stated. The company is granted exemption from duties on all construction material that may be imported during the next five years. The concessions are for a period of 99 years. The passenger fare is fixed at 6 cents per kilometer for first class passengers, 4½ cents for second class and 3 cents for third class.

The Copper Queen and El Tigre mining companies, of Sonora, have entered into a contract by which the mines of the El Tigre company and the town situated adjacent thereto are to receive electric energy from the large generating plant of the Copper Queen Company at Douglas, Ariz. The Mexican Government has granted a concession for the construction of an electric transmission line to El Tigre from the international border line. This transmission line will be 50 miles long. The survey for the route of the proposed line has been made and the construction material ordered.

Telephone Service in the United States.

A bulletin recently issued by the American Telephone & Telegraph Company gives some interesting statistics which show the extent of the use of telephones in the various cities of this country. The figures cover 113 cities with an aggregate of more than 2,500,000 Bell subscriber's stations; or, approximately 57 per cent of the total Bell subscriber's stations in the United States. These cities contain approximately 26,000,000 people; or, about 29 per cent of the total population of the country. The statistics show that second, third and fourth class cities use the telephone more extensively than do cities of the first class. The basis of judgment being the number of telephone installations per unit of population. The table herewith gives figures for several of the cities having a high percentage of telephones installed.

City	Population	Number of Phones	Phones per 100 Population
New Orleans	330,000	16,880	5.1
Louisville	278,000	11,431	4.1
Atlanta	125,000	14,224	11.4
Memphis	140,000	8,783	6.3
Salt Lake City	95,000	11,075	11.7
Richmond	115,000	11,440	9.9
Nashville	90,000	9,373	10.4
Bridgeport	100,000	6,944	6.9
Lowell	100,000	5,823	5.8
Houston	90,000	10,630	9.6
Ft. Worth	75,000	8,529	11.4

Evening Technical Courses at Brooklyn Polytechnic.

The College of Engineering of the Polytechnic Institute of Brooklyn, N. Y., announces for the season of 1910-1911 a series of evening and Saturday courses in engineering, chemistry, physics, mathematics, drawing, history, economics and languages especially designed to afford men in active practice opportunities for professional study. The courses may be taken independently or in connection with the regular courses in engineering leading to various engineering degrees. The term of study begins Oct. 3 and for those not seeking a professional degree no formal examinations for entrance are required. The courses in mechanical engineering are as follows: *Mechanical Drawing and Designing; Machine Design; Advanced Machine Design; Steam-Power Plants; Works Management; Gas Power; Works Engineering; Experimental Engineering; Steam Turbines; Steam Engineering;* and *Mechanism.* In physics and electrical engineering the following courses are offered: *Mechanics and Heat; Electricity and Magnetism; Alternating-Current Laboratory; Electrical Measurements; Direct-Current Dynamo Electric Machinery;* and *Electrotechnics.* Prof. W. D. Ennis supervises the courses in mechanical engineering and Dr. Samuel Sheldon the electrical engineering courses. The course in mathematics is designed to meet the requirements of engineers and is in charge of Dr. J. B. Chittenden.

Report of Ontario Board on Municipal Accounting Methods.

The fourth annual report of the Ontario Railway and Municipal Board, covering the year 1909, criticizes the action of some municipalities subject to its jurisdiction which fail to conform their accounting methods to the orders of the board.

The municipal corporations operating water-works plants, electric light plants, gas plants and telephone plants were asked during the year to furnish statements showing the results of the working of the utilities operated by them respectively. While in most instances the forms of report prescribed were completed and filed, with some municipalities the board found difficulty in obtaining adequate information relating to plants operated by them. The report says that some municipalities appear apathetic and indifferent in accommodating their methods of bookkeeping to meet the requirements of the board, and that other municipalities do not think it necessary to furnish any information whatever.

It is thus apparent, the board says, that it cannot be in a position to superintend properly the system of bookkeeping and keeping accounts of all the public utilities that are being operated by municipal corporations, as contemplated by section 57 of the Ontario Railway and Municipal Board act, unless some pressure can be brought to bear upon the municipalities in default to ensure the compliance, by all such municipalities, with the provisions of the statute. In some cases, where municipalities in default made application to the board to approve of debentures issues to meet the cost of additional outlays for the extension of public utility plants, the board found it necessary, in order to have full information on the questions before it, to defer certifying the debentures until the municipalities in default supplied the information required.

The board therefore renews a previous recommendation that in order to obtain the proper data and statistics necessary to intelligent analysis and study of the workings of public utilities it be empowered in cases where municipalities refuse to furnish the information required to appoint chartered accountants or other competent persons at the expense of such municipalities in default to obtain the information.

St. Lawrence-Long Sault Dam Project Halted.

From all information received it appears that the project of damming the Long Sault rapids of the St. Lawrence River, below Cornwall, is for the present shelved. Mention of this project was made in these columns for several weeks during November and December last. It will be remembered that international questions arose, and that the project met with strenuous opposition also from the shipping interests on account of the proposed dam and diversion of water. Subsequently the St. Lawrence Transmission Company filed amended plans with the various government departments interested by which it was hoped to meet the views of the opposing interests. The application of the company for the necessary authority has also been before the Waterways Commission for several months and as yet no report has been made. Under the Waterways treaty a new and permanent commission will have to be appointed, and there is reason to believe that the present body will go out of existence without having dealt with the proposed undertaking.

Stave Lake Hydroelectric Plant.

The Western Canadian Power Company, of which Mr. R. F. Hayward is chief engineer and general manager, will commence the delivery of energy to Vancouver next April. The plant is situated 35 miles distant from Vancouver and 7 miles from Ruskin, a station on the Canadian Pacific Railroad. It is stated that the storage capacity is so great that the plant could be operated at a capacity of 100,000 hp for 90 days in the absence of any flow into the reservoir during that period.

The power house is being built in a pit immediately below the dam, from which a tail-race 60 ft. wide will be dredged for a distance of a quarter of a mile down stream. In the power house will be installed four turbine units of 13,000 hp each. These will operate from four penstocks, each 14 ft. 6 in. in diameter led from the face of the intake dam 110 ft. above the generating plant. At present plans are made for the early installation of two of these units, the other two to be put in place as soon as the market for energy demands. It is expected that the call for energy will have so developed that the last unit will be in operation early in 1912. The hydraulic work now being carried out will, when finished, be complete for four units, though only two will be installed this year. The turbine wheels will be direct connected to generators which will deliver three-phase currents at 4000 volts, which will be stepped up by transformers at the power house to 60,000 volts for transmission to Vancouver. At a receiving station there the voltage will be stepped down to 12,000 volts for distribution to local substations from which in turn it will be further distributed at 2300 volts.

Canadian Hydroelectric Commission News.

Mr. W. K. McNaught, M. P., member of the Hydroelectric Commission, at a meeting of the convention of the Canadian Municipalities in Toronto, announced that energy from Niagara Falls would be sent regularly to Toronto over the commission's transmission line on and after Oct. 1 next. Mr. McNaught also stated that the transmission of energy to Berlin would begin on Sept. 5 and the line would be completed to London on Oct. 15. On Nov. 15 the Stratford-Berlin line and all the smaller lines of the system would start transmitting energy. At present the line is finished as far as Dundas.

Mr. McNaught stated that the commission's plant and lines had been constructed without exceeding the cost as originally estimated. The estimate had been $3,749,000, and the cost would be $3,330,000, notwithstanding the fact that a protective system costing $106,000 and transformers costing $41,000 had not been anticipated, although the right of way had cost $400,000 instead of the $227,000 at first expected. The commission, according to Mr. McNaught, is now working out a plan to provide energy for Prescott, Kingston, Brockville and other eastern Ontario towns along the St. Lawrence River.

A new contract has been made by the commission for the delivery of 1500 hp additional to be used in Ottawa and Hull, the price to be $15 per horse-power per year. Some months ago the commission contracted to deliver 1500 hp to Ottawa, and this was used for municipal purposes, such as lighting, etc. Later on the order was increased by 1000 hp. The present contract will bring the total delivery up to 4000 hp.

The first test of Niagara energy over the commission's main transmission line from the Falls to Dundas was made on Sept. 1. Hon. Adam Beck, chairman, who was present at the test, declined to make any statement, preferring to await the return of Premier Whitney before announcing that the plans of the Government had upon their first trial met with success.

New York Commission News.

On Wednesday of this week the Public Service Commission, Second District, will give at Albany a hearing upon the proposition of entering an order requiring gas and electrical corporations to file tariffs and prescribing a form of such tariffs. Up to the present time only railroads have been required to file their tariffs with the commission.

On Sept. 1 the Public Service Commission, Second District, assumed jurisdiction over the operations of telephone and telegraph companies operating in the state. All telephone companies, corporations, associations, partnerships or persons owning or operating any telephone line in the state for profit whose property is valued at over $10,000 will come under the supervision of the commission. All telegraph companies, however, are within the jurisdiction of the commission.

Complaints may be made to the commission by any person or corporation aggrieved as to rates, rentals and service by petition or complaint. The commission may also make investigations upon its own motion. The commission has power to order necessary repairs and changes. All franchises and privileges hereafter granted must be approved by the commission before they can be lawfully exercised. Issues of stock, bonds and other forms of indebtedness must be consented to by the commission. The commission has power to enforce its order, rules and recommendations, and failure to comply with same may result in actions to recover penalties.

The commission has opened a New York City office in the Metropolitan Tower, and has also established an office in Buffalo. Edward B. Rogers, of Elmira, a telephone man of 22 years' experience, has been appointed chief of the division of telephones and telegraphs at a salary of $4,000 per annum

Maryland Commission News.

The Public Utilities Commission has received numerous protests against the new schedule of rates which were submitted by the Chesapeake & Potomac Telephone Company. The commission is holding the schedule under advisement and, although the company was willing to allow the lower rates to go into effect on Sept. 1, the commission decided that the old rates must prevail until the members of the commission would have an opportunity to go more deeply into the matter. There is opposition to the sanction of the new rates on the grounds that the unlimited telephone service in the business district would be abolished entirely. Many business men have appeared before the commission in person and others have sent letters urging it not to adopt the new rates. The commission will receive complaints until Oct. 24 when the matter will be given a final hearing.

Aside from the matter of unlimited service other complaints have been made against the service of the Chesapeake Company. One complainant points out to the commission that when a pay station is used the nickel must be deposited in the slot before the party who is telephoning gets the person on the wire, regardless of the fact that the party to whom he wishes to speak may not be in at the time. The same system used for long-distance calls is desired whereby the name is given to the operator and the toll is not paid until the person called is at the other end of the wire. It is believed that the commission will order this change made. Another important thing in connection with the service of the company was brought to the attention of the company. A large business house that has unlimited phone service has complained that a strict account it has kept of the number of calls used during the past year does not accord with the bill rendered by the company, and in almost every communication the commission receives the complaint is made that the subscriber has no way of ascertaining whether they are being overcharged or not. The demand is being made by some that the company be compelled to furnish subscribers with some sort of an indicator that will register the number of calls that are used.

The professional men of Baltimore have interested themselves in the question of unlimited service, and several communications have been received from prominent lawyers stating that the telephone company is compelled to furnish its patrons with unlimited service by an act of the Maryland Legislature.

A letter, reprinted in part below, from the Stewart Fruit Company, of Baltimore, illustrates the general complaint that is being voiced. "Some years ago the telephone service in Baltimore became so obnoxious that an association was formed of telephone subscribers to try to remedy existing evils. They went so far as to have a bill passed by the Legislature requiring the telephone company to furnish telephones at a stipulated price per station. The Chesapeake & Potomac Company then came out with a "metallic circuit" contract for which service it asked more money than the amount authorized by the Legislature on what it called a "grounded wire" service. For this metallic unlimited service we pay $125 per annum. We are not satisfied to be put on a call basis, and we most strenuously object to the revocation of our contract. Formerly we were allowed five minutes on long distance and toll board calls; now we are only allowed three minutes, and if we talk 16 seconds over the time, we are charged for one extra minute. We consider the telephone a public necessity and we believe the public generally should have the benefit of the best service obtainable at the least cost consistent with a fair remuneration to the stockholders on the actual amount of investment. We have one limited and three unlimited Chesapeake & Potomac telephones, together with two extensions and also a Maryland telephone and extension. The bill presented us by the Chesapeake & Potomac Company for the past month is $234.50, which bill must be paid without question. We defy anyone to check these bills, or to keep a check against them."

Massachusetts Commission News.

The New England Telephone & Telegraph Company has announced that it has accepted the ruling of the Massachusetts Highway Commission in connection with its investigation of telephone rates in the Boston and suburban district. The company will begin at once to prepare for the changes in its system which the establishment of the new rates will bring about. About 100,000 contracts will probably be rewritten. The company expects by Nov. 1 to be able to offer service in any exchange, in accordance with the new schedule, to those who desire it.

A concerted effort is being made by several suburban cities and towns at the north of Boston to secure a stay of proceedings by an appeal to Governor Draper, but in view of the thoroughness of the investigation of the Highway Commission and its engineers, Messrs. D. C. and W. B. Jackson, it is considered unlikely that the Governor will interfere. The line of cleavage between those in favor and those opposed to the new rates exists chiefly in connection with the proposed adoption of a zone system of charging. In the past the service offered on the unlimited basis between the various Boston suburbs has been probably unequaled in extent in any other city of the world, but this freedom of communication has been handicapped to no small degree in the mind of the average telephone user by the existence of toll charges between the suburbs and the Boston business district. The situation has been somewhat analogous to the offering of unlimited service between the residential portions of a city, with a toll charge of from 5 to 10 cents per call downtown. Under the new rates the toll charge to the center of Boston is to be reduced to 5 cents per call for all stations within 8.5 miles of the congested center, and to offset this restrictions will be placed on intersuburban communication. The commission also hopes to bring about a better degree of equalization in the charges for different classes of service by the use of the zone system.

The selectmen of Lenox have petitioned the Massachusetts Railroad Commission to investigate the question of establishing a 5-cent fare from any point on the line of the Berkshire Street Railway Company in Lenox to any other point on the railway within that municipality. Half-hourly car service is also requested. The board will hear the case of the selectmen of Lenox on Sept. 14.

The Railroad Commission has issued an order approving the issuance by the Connecticut Valley Street Railway Company of 200 shares of 6 per cent preferred capital stock at a price of $100 per share. The proceeds are to be used for retiring an equal amount of the bonds of the company dated June 1, 1909. Upon the issuance of the stock bonds to the amount of $20,000 are to be canceled and destroyed. The 200 shares of preferred stock are to be sold at auction in the city of Boston to the highest bidder, in accordance with the desire of the directors, on the ground that the amount of the issue does not exceed 4 per cent of the company's existing capital stock.

The board has also approved an issue by the Milford & Uxbridge Street Railway Company of coupon or registered bonds to an amount not exceeding at par value $85,000, payable Jan. 1, 1918, and bearing 5 per cent interest. The proceeds are to be used in paying floating indebtedness incurred in construction and equipment.

The Massachusetts Railroad Commission gave a hearing on Aug. 30 to the Boston & Eastern Electric Railroad Company for the purpose of listening to arguments of counsel on the question of reopening the matter of granting a certificate of public convenience and necessity to the company. The board recently recommended by a majority vote that nothing be done at present to give the company a certificate. For the company, its attorney, C. S. Baxter, Esq., emphasized the large public demand for the road which has been evidenced, and contended that Chap. 630, Acts of 1910, has been improperly construed by the board.

The law in question gave the company authority to build a tunnel under Boston Harbor, for the purpose of securing a city terminal. Mr. Baxter said that the electric railway law of 1906 predicated the construction of the high-speed electric railroad in Massachusetts. In spite of the recommendations of the Boston Transit Commission and the Massachusetts Railroad Commission to the Legislature of 1910 recommending that the authorization of the Boston & Eastern tunnel be put off until later, the 1910 tunnel law was passed by a large majority, thus making it clearly known to the board and to the public that the General Court desired to have the road built and constructed without delay.

The Boston & Eastern company contends that the commission has exceeded its discretionary power and has misconstrued the action of the Legislature. Mr. Baxter said that if any commission delayed its business on account of legislation that might take place in the future, no public improvement would ever be effected. The company feels that it has a legal right to a certificate under the decision of the board two years ago, which stated that a need existed for additional facilities in the territory. The hearing was then closed by order of Chairman Hall.

A petition has been presented to the Railroad and Boston Transit Commissions by James Grant, secretary of the League of Street Car Users, asking for an investigation of the conduct and management of the Boston Elevated Railway Company. The next Legislature will consider a number of important questions bearing upon the future of the company and its relations to the community and connecting street railways. The petitioners contend that the boards should determine whether the management and conduct of the road in the past, in competition with certain other systems in part at least, and as lessee of other railways and subways for a limited period only have been so businesslike, economical and considerate of patrons' welfare as to justify the conclusion that its powers ought to be so extended as to exclude all possibility of competition. The two commissions are to report to the next Legislature upon these matters, which include the advisability of the Boston Elevated Railway Company's purchasing the West End Street Railway Company, acquiring control of other railways in the interest of operating economy and improved service, and extending the leases of the Washington Street tunnel, the Tremont Street subway and the East Boston tunnel.

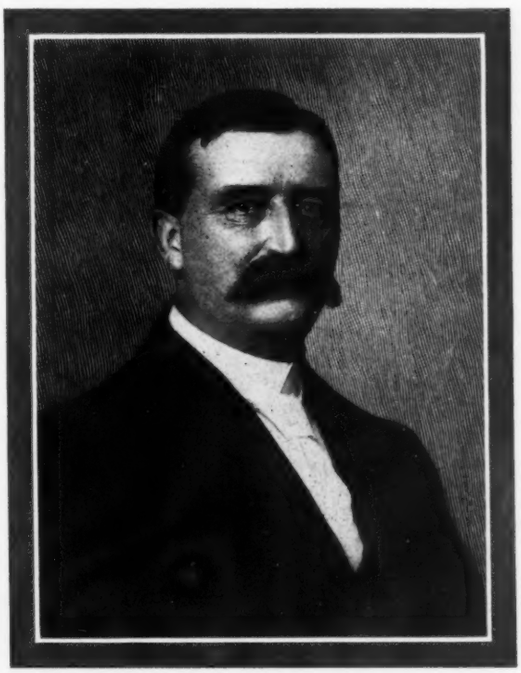
Bids have been received by the Boston Transit Commission for the construction of the Boston Common section of the Cambridge subway, including terminal arrangements at Park Street. The cost of the work will be about $290,000. Excavated material will be handled by electric trains at night after the subway tracks are closed to regular traffic.

AMERICAN ELECTRICAL ENGINEERS.—XIII.

James A. Lighthipe.

James Alfred Lighthipe was born in Orange, N. J., Dec. 29, 1857, and received his education in the public schools of his native town and at Stevens Institute. In 1879 he entered the Edison laboratory at Menlo Park, where Mr. Edison at the time was engaged in perfecting the loud-speaking chalk telephone and experimenting with the carbon-filament incandescent lamp. The first Edison phonograph had just then been invented and Menlo Park was so besieged by representatives of newspapers and curious visitors that all of the serious work of the inventor and his staff had to be carried on at night.

The Edison telephone patents had just been purchased by the Gold & Stock Telegraph Company, which owned and operated the stock tickers. The subsequent sale of these rights to the Bell Telephone Company, and the substitution of the magneto bell for the battery and push button finally brought the telephone to a commercial stage, and companies were being organized for its operation in all large centers of population, both in America and Europe. This led to many requisitions on the Edison laboratory for telephone experts to direct the work of installation,



Mr. James A. Lighthipe.

and Mr. Lighthipe was, with others, sent abroad for this purpose. When he reached London, in 1879, there were approximately 500 telephones in the entire British Islands, as up to this time the telephone had been regarded merely as a scientific or experimental instrument. Antwerp was the next of the European cities to call for a commercial telephone service, and under the auspices of the International Bell Telephone Company, which controlled all the telephone patents for the Continent, Mr. Lighthipe vigorously took up the work of installing systems in the principal cities of Belgium. This occupied his attention until 1881, when he returned to London as superintendent of the British Insulite Company, and was for the ensuing six months engaged in perfecting the process of manufacturing composition insulators.

When Mr. Charles Batchelor started the Edison manufactory at Ivry, just outside of Paris, known as the Société Industrielle et Commerciale d'Edison, Mr. Lighthipe joined the staff and remained a member for the ensuing year. His next appointment was that of electrical engineer for the German Edison Company at Berlin—the Deutsche Edison Gesellschaft—with which he remained for a year as expert in connection with various installations throughout Germany. Returning to the United States, in 1884, he joined the Brush Company in New York City, and was subsequently engaged for a short time in business for himself in Philadelphia, manufacturing electrical novelties. In 1886 he accepted a position as electrical engineer for the Wilmington City Electric Company, at Wilmington, Del., and supervised the construction there of a three-wire Edison plant.

In the latter part of 1889 Mr. Lighthipe was engaged as superintendent of construction by the United Edison Manufacturing Company, with main offices at San Francisco, Cal., and acted as district engineer and local engineer for its successors, the Edison General Company and the General Electric Company. He had charge of the electric construction of the first electric railway on the Slope, which was built in Los Angeles in 1891. During his connection with the work of the General Electric Company on the Pacific Coast, Mr. Lighthipe was identified with the construction of pioneer electric roads at San José, Oakland and Sacramento, and of the pioneer long-distance transmission systems of Folsom-Sacramento. Fresno, Bakersfield and Santa Ana-Los Angeles. In one capacity or other he has been identified with the building of all the large transmission lines west of Salt Lake City.

In 1908 Mr. Lighthipe resigned his position with the General Electric Company to become electrical engineer for the Edison Electric Company, of Los Angeles, subsequently the Southern California Edison Company, a $30,000,000-organization, which operates hydroelectric plants on four mountain rivers and supplies electrical energy in Los Angeles and to 55 cities and towns in southern California. He is at present engaged in supervising the construction of a $6,000,000 steam auxiliary plant which his company is building on the ocean at Long Beach, Cal., and assisting in the preparation of plans for future hydroelectric development.

Notwithstanding his activities in the electrical field, Mr. Lighthipe has found time for other interests of a practical nature, notably the cultivation of citrus fruit. A 30-acre lemon grove at Rialto, Cal., has, under his direction, been developed to a model horticultural exhibit. Mr. Lighthipe has been a member of the American Institute of Electrical Engineers since 1894, and for the past year has been chairman of the Los Angeles A. I. E. E. local section.

CURRENT NEWS AND NOTES.

Mr. Roosevelt on Public Service Regulation.—During his Osawatomie (Kan.) speech of Aug. 31 Mr. Theodore Roosevelt declared for complete and effective publicity of corporate affairs. He continued, according to the newspaper report: "It has become clear that we must have government supervision of the capitalization not only of public service corporations, including particularly railways, but of all corporations doing an interstate business. I do not wish to see the nation forced into ownership of the railways if it can possibly be avoided, and the only alternative is thoroughgoing and effective regulation, which shall be based on a full knowledge of all the facts, including a physical valuation of the property."

Edison Favors Municipal Ownership of Homes.—A member of the Milwaukee city government reports that Edison favors the policy of the present government of that city in connection with the municipal ownership of land and dwellings. He is reported to have said: "My message to Milwaukee is that her's is a great opportunity. The city can buy the land, subdivide and improve it with streets and parks. It can build wholesome, comfortable houses, with all modern conveniences, and can put them on the market on a large scale at a cost not to exceed $800 each. At these figures the dollar-a-day man can own his own home. The city can make it certain that he will. It can borrow money for 5 per cent and sell the houses on installments at, say, one-fourth of what these working people are now paying in rents. In this way the city expends nothing and the working people will expend only one-fourth of what they are now paying for unsanitary, uncomfortable and wretched places of residence."

Quarry Street Station, Chicago.—The work of completing the Quarry Street station of the Commonwealth Edison Company, Chicago, is proceeding steadily. Five of the six 14,000-kw turbo-generators are now in service, and the remaining one will probably be in commission in a few months. Unit No. 5 is a 12,000-volt, 60-cycle machine, and is the first of this description that the company has installed. Nearly all of the large generators of this company are wound for 9000 volts.

Railway Signal Electric Lighting.—On the Baltimore and Ohio Railroad, where the Patenall and Dryden system of automatic electric lighting of lamps on the approach of trains has been in operation for several years, one of the lamps put in operation on Aug. 1, 1906, was burnt out on Aug. 5, 1910, having thus given a continuous service of over four years. During this period the lamp was lighted and extinguished, automatically, 73,200 times. The lamp was a 2-cp, 11-volt lamp, purchased at an electrical supply store.

Advertising in Foreign Languages.—In cities where there is a considerable foreign population public-service companies often find it of advantage to advertise in the daily or weekly newspapers published in foreign languages. In St. Louis, for instance, the German element is a strong one, and the German papers are carefully edited and widely read. The Union Electric Light & Power Company, the Kinloch Telephone Company and other electrical concerns find it profitable to carry conspicuous advertisements in these German papers.

Association of Railway Electrical Engineers.—As noted in the issue of Aug. 4 the Association of Railway Electrical Engineers will convene in the Hotel La Salle, Chicago, Sept. 27-30. The subjects of the papers to be presented have just been announced as follows: *Electric Lighting of Railway Cars, Axle Generating Systems, Electric Traction on Trunk Lines, Motor-Driven Machine Tools* and *The Illumination of Railway Passenger Stations and Machine Shops.* A feature of the convention will be the exhibits by the member companies of the Railway Electric Supply Manufacturers' Association.

Electricity in Equitable Building, St. Louis.—The Equitable Building at the corner of Sixth and Locust Streets, St. Louis, has been completely remodeled, and the entire supply of electricity is now obtained from the Union Electric Light & Power Company. The isolated plant located in the basement of the old building has been dismantled and removed. The building is 10 stories high and will be equipped with three high-speed electric elevators, while lighting will be furnished by about 3000 incandescent lamps. The total load will be about 290 hp.

New Aluminum Alloy.—The great British firm of Vickers Sons & Maxim have announced that it will put on the market in October a new aluminum alloy, which, it is claimed, is superior to anything heretofore known. It is the discovery of the company's chief chemist, Mr. Weeks, who says it is as strong as steel, while its weight is one-third that of brass, or only slightly heavier than aluminum. It can be rolled, drawn, stamped and forged. It is less subject to corrosion than any other aluminum alloy. The firm has patented the alloy, which is called duralumin throughout the world. It will establish a plant at Birmingham to manufacture it on a large scale.

Public Library Station in Central-Station Headquarters.—The Commonwealth Edison Company of Chicago maintains for employees a technical library and reading-room at its headquarters, the Edison Building, 139 Adams Street. This department is in charge of a trained librarian, who, among other duties, issues a weekly digest of articles in current technical literature of especial interest to central-station readers. Further, there is a station of the Chicago Public Library connected with the company's library in the Adams Street Building, and the librarian will give her assistance in procuring books on non-electrical subjects on request. Plans are now in preparation for the establishment of a branch library of the Commonwealth Company in the building at 84 Market Street.

Terminal Electrification Commission for Chicago.—It is suggested by the Chicago *Tribune* that the problem of electrifying the railroad terminals in Chicago, and particularly that of the Illinois Central Railroad, which is a "persistent, stubborn and somewhat callous offender" in relation to the smoke nuisance, be referred to a commission of experts. Such a commission should be carefully chosen and provided with facilities to investigate the whole local situation, reporting a complete scheme of action. The commission plan has worked well in Chicago in carrying out track elevation of steam railroads and the rehabilitation of surface street-railway traction. A definite, practical beginning upon the plans for electrification should be insisted upon immediately, and the commission plan affords a sensible method which may be undertaken on a broad and comprehensive scale.

Haverhill (Mass.) Gas Case.—By a decree issued on Aug. 31 by the United States Circuit Court the price of gas furnished by the Haverhill Gas Light Company has been set at 90 cents per 1000 cu. ft. for the period between July 1, 1910, and July 1, 1911. The next corresponding year the price is to be 85 cents, and thereafter it is to be 80 cents, providing the company sells 450,000,000 cu. ft. at 85 cents. This decision ends a dispute which has lasted for 10 years between the company and the Massachusetts Gas & Electric Light Commission. In 1900 the board fixed the price of gas at 80 cents, and since that time the company has fought the decision on the ground that it was impossible to manufacture gas of the quality desired at the commission's price. The commission is restrained under the decree from filing suit against the company in relation to its prices, but the board's price will ultimately be adopted.

Central-Station Service for Chicago Hotels.—The Union Restaurant and Hotel, of 111 Randolph Street, Chicago, has abandoned its isolated plant, and now takes its supply of electrical energy from the Commonwealth Edison Company. Electricity is required to operate electric motors with a combined rating of between 90 hp and 100 hp, and also incandescent lamps equivalent to 1350 16-cp lamps, as well as a small number of arc lamps. The motor equipment includes an electric elevator, a large ice machine, ventilators, etc. Steam for heating is secured from an outside source. Another hotel to abandon its isolated plant and take electricity from the Commonwealth company's mains is the old Revere House at North Clark and Michigan Streets. Here the lighting equipment consists of between 700 and 800 16-cp equivalents, while motors of a total rating of about 25 hp are operated. A steam elevator is now in use, but this will be taken out and an electric elevator substituted.

Telephone Charges in London.—The annual charge for telephone connection with any exchange in the county of London within two miles of the subscriber's premises is £5 ($24.32); message fees, 2 cents for each call to a subscriber on any exchange in the county of London, and 4 cents for each call to a subscriber in any exchange outside of the county. The annual charge for connection with any exchange outside the county of London, within two miles of the subscriber's premises, is £4 ($19.46); message fees, 2 cents for each call to a subscriber on the same exchange, and 4 cents for each call to a subscriber on any other exchange. The minimum yearly amount payable by each subscriber for message fees is $7.30. The telephone trunk lines which connect the various telephone exchange areas throughout the Kingdom can be used by callers at postoffices which are connected with the trunk telephone system, as well as by subscribers and callers using telephone exchanges. The fees for the use of the trunk lines are as follows: Up to 23 miles, 6 cents; 23 to 50 miles, 12 cents; 50 to 75 miles, 18 cents; 75 to 100 miles, 24 cents; every additional 40 miles or fraction thereof, 12 cents.

CENTRAL STATION AT MOLINE, ILL.

Combination Low-Head Hydroelectric and Steam-Generating System Serving Three Closely-Connected Cities.

FEW generating companies are as fortunate in having a large market for energy within easy transmission distance as is the one operating at Moline, Ill. In that neighborhood are three cities, Moline and Rock Island in Illinois, and Davenport across the river in Iowa, within a distance of from two to four miles of each other, and having an aggregate population of probably 75,000. The conditions approximate those of a large city. Careful organization has resulted in the concentration of the generating equipment in one central plant for the three cities, this plant being located in Moline, with substations in Rock Island and Davenport. The electrical installation for these towns is fairly well up to date, and hence a description of it may be of interest to electrical men.

The central station itself consists of two parts, a steam generating section and a smaller hydroelectric section. The two parts are parallel to each other about 200 ft. apart. The coal is handled mechanically, and is crushed unless screenings can be had. The grates are of the Roney and Green chain type and the coal consumption per 24 hours varies from 75 tons to 130 tons. The generating room is 287 ft. x 80 ft., and contains both engine and turbine equipments. There are three direct-connected cross-compound engine units, consisting of a 1000-kw alternator, a 1100-kw alternator and a 150-kw direct-current generator for exciting purposes. The last-named is run by a Buckeye engine at 250 r.p.m. The two large engines are Allis-Chalmers machines and the generators Westinghouse units.

Of the turbine units there are at present two. The larger has a rating of 3000 kw and the smaller of 1500 kw. The turbines are of the Westinghouse-Parsons horizontal type, and the generators are Westinghouse fan-ventilated machines. The speed of each is 1200 r.p.m.

The switchboard has 54 panels. It is of gray and white marble. The total connected load of the station is about 10,000 kw. Of this, 4000 is railway, 3000 stationary motor load and 3000 is peak lighting. This load, with the present equipment of the plant, does not leave sufficient reserve. The company is now installing a 7500-kw turbo-generator, of the same make as

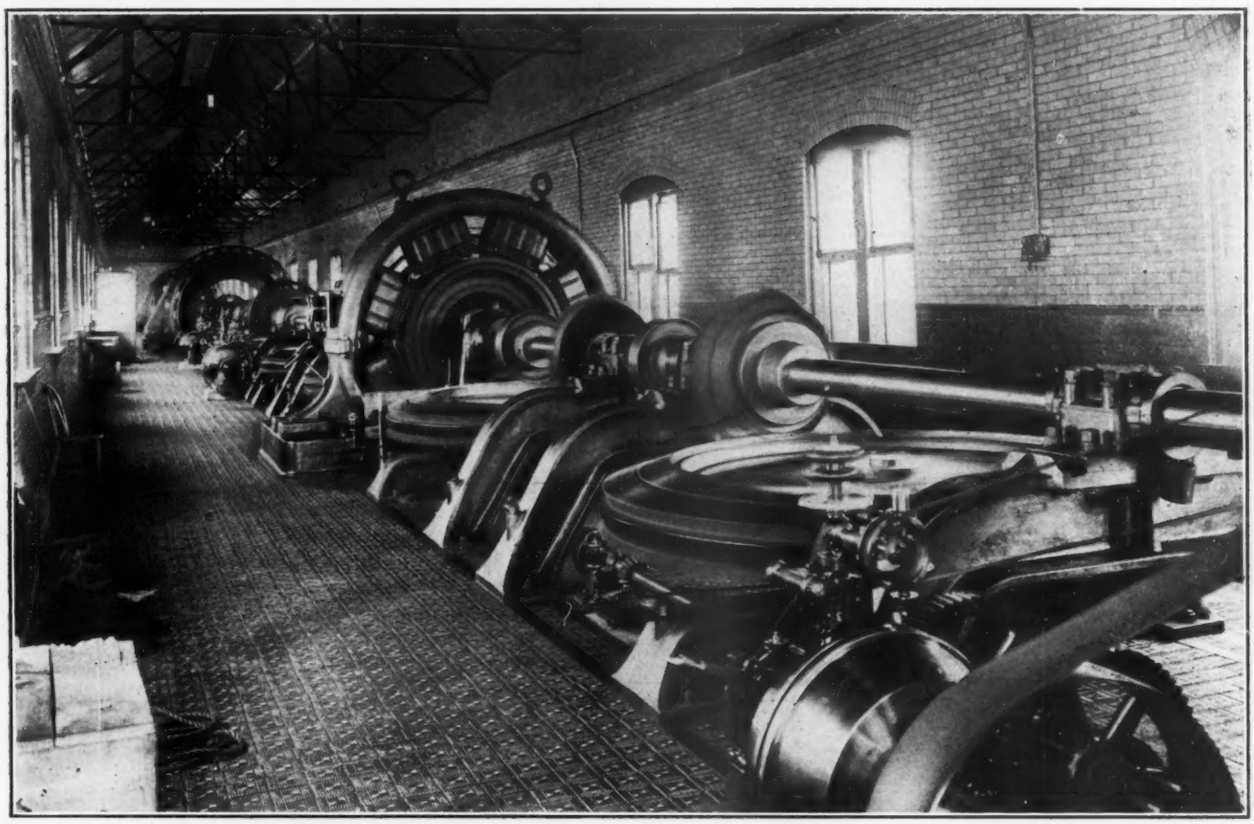


Fig. 1—Interior of Hydroelectric Generating Station.

size of the hydroelectric room is 300 ft. x 25 ft. It contains only three generators, each rated at 600 kw. It was necessary to use a room of large size in order to provide for the drive shafting, because the operating head of water is so low that six turbines are required for one generator, and seven for each of the other two. The generators are directly connected to the line shaft. One of them is a direct-current machine, and the others are alternators.

The turbines are 20 in number, of the vertical type, and operate under an average head of 9 ft. at a speed of 66 r.p.m. Each turbine is rated at 100 hp. It is thus seen that the hydroelectric section comprises about 2000 hp. The head is secured by means of cross dams and a few long islands, and thus represents merely the difference in level between the upper end of these and the water-power house.

In the steam section there are 11 500-hp Stirling water-tube boilers, furnishing a working pressure of 200 lb. The the above, and four new 650-hp Stirling water-tube boilers fitted with Illinois chain grates.

The primary alternating-current energy is supplied at a pressure of 4800 volts, two-phase, 60 cycles, which makes unnecessary any step-up transformers. The city of Moline is lighted directly from the central station. On the streets use is made of General Electric arc lamps and for this service there are six constant-current transformers in the station. The farthest transmission distance is about three miles to the substation in Davenport. In the Davenport substation are two 600-hp induction motors taking 54.3 amp per terminal at the primary pressure. Besides these there are three rotary converters, two of 300 kw each, and one of 200 kw, giving direct-current energy for the railway at 550 volts. The two larger converters have a speed of 600 r.p.m., with a rated ampere load of 546 each, while the smaller has a speed of 720 r.p.m., with a rated ampere load of 364. The direct-current generators

direct connected to the big induction motors are rated at 667 amp and 600 volts, and run at 580 r.p.m.

The station contains four Brush arc machines in two pairs, each pair being driven by a 200-hp synchronous motor placed between the machines. Each motor takes 17 amp at 4400 volts, and operates at 514 r.p.m. These motors are of the General Electric type, while all of the railway generators are Westinghouse machines. The rest of the Davenport arc load is carried on two constant-current transformers and mercury-arc rectifiers adjusted for 6.6 amp. There are two switchboards, the smaller having 10 panels, the larger 20. There

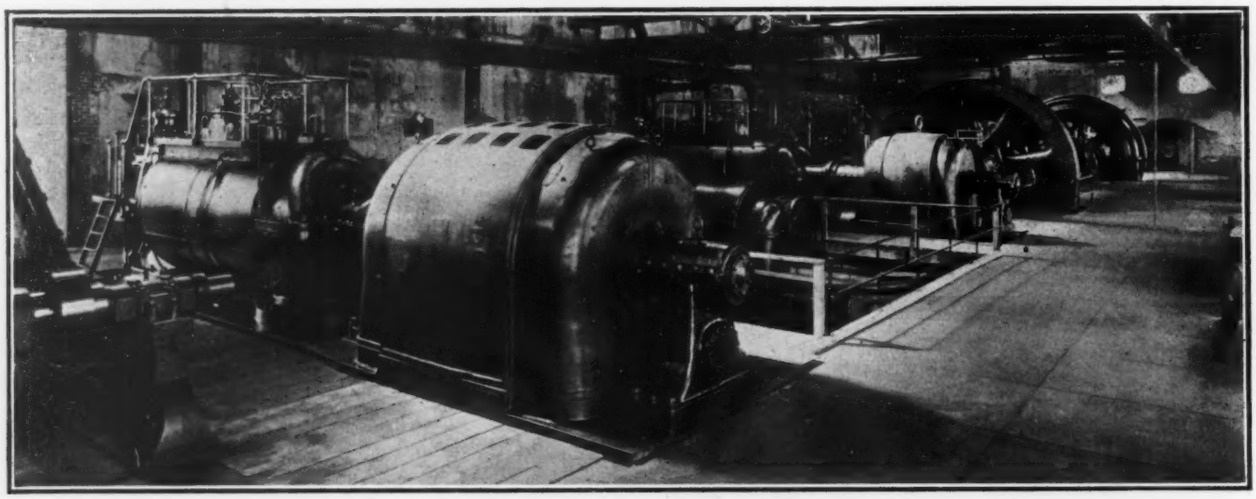


Fig. 2—Interior of Steam-electric Generating Station.

are also two exciter sets, each driven by a 15-hp induction motor, requiring 33 amp at 220 volts. The generators furnish the customary 125-volt service, the armatures having a speed of 1200 r.p.m.

There are seven regulator transformers, three of 16.5 kw rating each, and four of 20 kw each. The regulation is 10 per cent, in 14 steps, 2200 to 220. Besides these there are 13 ordinary constant-potential oil-cooled transformers, having ratings of 150 kw, 300 kw or 500 kw, with two of 110 kw and three of 165 kw. This substation also contains a large horizontal engine-type railway generator for use in emergencies. The substation in Rock Island is so similar to that just described that a separate detailed description is not needed.

A RECENT ISOLATED PLANT INSTALLATION FOR COUNTRY RESIDENCE LIGHTING.

By W. D. Cassin.

THE country estate of Mr. Edwin P. Baugh, located on the Severn River, near Annapolis, Md., has recently been improved by a large mansion equipped with every modern convenience, including a reservoir, pumping plant and electric lighting plant. A large spring, located 300 ft. from the mansion, forms the main water supply, from which the water is pumped to a concrete reservoir on a hill 170 ft. above the spring level; from here it flows to the house by gravity. Immediately adjacent to this spring is a power house built of heavy pine timbers with foundation and floor of solid concrete 2 ft. in thickness. This power house is of the dimensions and plan as shown in Fig. 1.

The mansion is equipped with a three-wire system, having the neutral wire the same size as the outside wires, and contains in the various circuits 350 incandescent lamps of 4 cp, 8 cp and 16 cp. To supply energy for these circuits a plant has been installed of the following description:

The generating unit consists of a 7-kw, 125-250-volt Westinghouse, single-bearing, three-wire, compound-wound generator, coupled direct to a Fairbanks single-cylinder, 12-hp, gasoline engine operated at 360 r.p.m. This engine is especially designed for lighting service and represents the most approved gasoline engine practice, giving a speed regulation for the unit of 2 per cent from no load to full load. This unit is capable of supplying energy for 125 16-cp, 110-volt carbon lamps.

In addition to the above there is a storage battery consisting of 58 cells made by the Westinghouse Storage Battery Company and giving 116 volts pressure. The discharge capacity of this battery is 28 amp for five hours. The positive and negative plates of this battery are made of pure lead, without tin, antimony, or other alloy, with the active material formed from a Planté process with sulphuric acid as the electrolyte. This construction gives freedom from sulphation.

For controlling this outfit there is a switchboard consisting of one combination panel built of black, marine-finished slate, and mounted on gas-pipe framework. This panel carries the necessary meters and switches, as indicated in the circuit shown in Fig. 2. It will be noted from this circuit that the battery is charged from the outside, or 250-volt leads of the generator, through fixed resistance, both switches being thrown up to the charge position. It will be noted also that with the switches

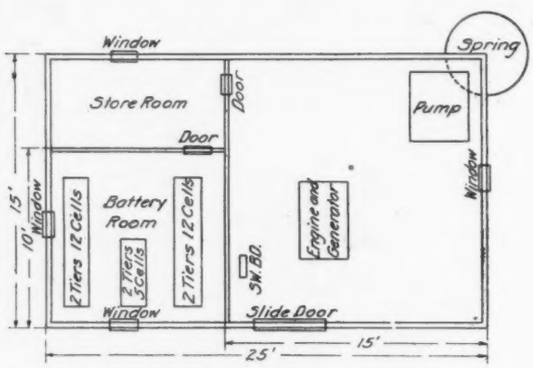


Fig. 1—Plan of Engine and Battery Rooms.

thrown up to the charge position the generator will feed the lighting circuits at the same time the battery is being charged, the battery being analogous to a 220-volt motor on a three-wire system. When operating lamps from the battery direct the switches are thrown down to the discharge position, thus tying together the two outside wires of the system and producing thereby a two-wire, 110-volt system. In this position of the switch the generator circuit is entirely open and it will be noted that the arrangement is fool-proof. It will also be noted that there are three possible ways of operating this plant: (1) Lamps operated from the generator; (2) lamps operated from the generator, the battery being charged at the same time;

(3) lamps operated from the battery direct. The two circuit-breakers in the outside leads of the generator are equipped with reverse-current relays to prevent back-flow of current from the battery. The switchboard is connected to a distributing panel in the basement of the mansion by a three-conductor, lead-covered cable laid in glazed terra-cotta conduit.

This plant has now been in operation six months and is giving entire satisfaction and proving ample in capacity to meet the

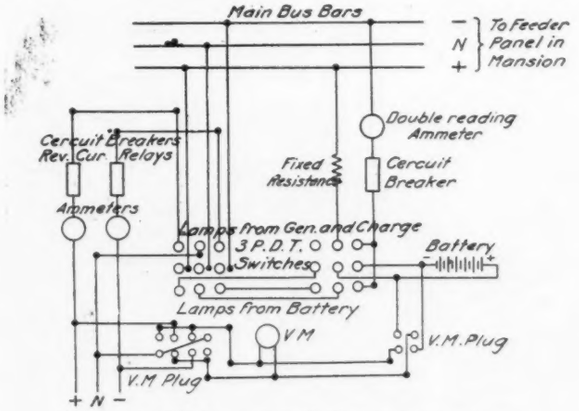


Fig. 2—Diagram of Switchboard Connections.

demands upon it. For special occasions when the greater part of the mansion is lighted the energy is furnished direct from the generator. For ordinary use the battery will furnish necessary energy for two nights without recharging.

The close regulation of the generating unit gives a very steady light entirely free from any pulsation. This plant embodies the usual feature of an isolated plant of this nature, but is of special interest on account of the three-wire feature.

WIRELESS FOR A TRANSATLANTIC AIRSHIP.

By F. M. Sammis.

THE dirigible balloon *America*, with Walter Wellman as pilot, that is to attempt the remarkable feat of crossing the Atlantic Ocean during the month of September, is being equipped with a special set of wireless telegraph apparatus by the Marconi Wireless Telegraph Company. In order better to describe this pioneer wireless equipment of an airship, and its method of operation, perhaps a few words descriptive of the dirigible itself may be helpful.

The huge cigar-shaped envelope is 220 ft. long. It has been constructed from a specially woven fabric of rubber and silk, well adapted for containing the hydrogen gas without leakage. Suspended from the gas bag by means of rope slings and steel guy wires is the car. This car is constructed entirely of steel tubing, braced with steel guy wires, and upon it and the platform which it supports are mounted the main and auxiliary gasoline engines, the former consisting of two 80-hp units and the latter developing 20 hp. These engines drive the four propellers that furnish the motive power. A huge gasoline tank, 150 ft. long and 2 ft. in diameter, is also supported by the main car body. Suspended directly underneath the steel car is an indestructible and unsinkable life boat. In a locker in the forward end of this little craft is located the wireless equipment.

Attached to the underneath side of the steel car, but insulated from it by special rope insulators, is the steel drag rope. The device, while common to the ordinary balloon, has a unique feature worth mentioning. It will, of course, be understood that the function of this drag rope is to equalize the variation in lifting power of the hydrogen gas, owing to the expansion and contraction due to sunlight and darkness. In order to combine a large amount of equalizing weight with increased storage capacity for gasoline, a number of special steel tanks have been constructed, each having a capacity of about one barrel. These tanks are made with hollow centers so that they may be slipped over the steel drag rope, one above the other; thus they can be drawn up into the car and their contents used should occasion require.

In designing the special wireless telegraph equipment for the *America* two requirements were of great importance; first, minimum weight, and second, freedom from danger in operation. In consequence of the importance of these considerations the set was constructed with an exceptionally loose coupling, and operates on energy furnished by a small storage battery which in turn is charged with a miniature gasoline engine generating set used for lighting. This little generating set is a model of compactness.

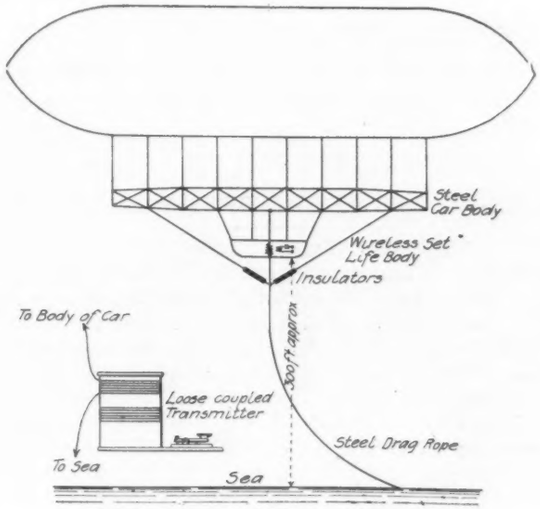


Fig. 1—Diagram of Transmitting Circuits.

Reference to the diagram will make clear the method of connection. The ground end of the secondary winding of the oscillation transformer is connected to the steel cable or drag rope previously described, the aerial end being connected to the steel body of the car. The writer feels quite safe in making the statement that this will be the first instance in which a string of a dozen cans, each containing a barrel of gasoline, has been used as a wireless antenna.

In arranging the coupling of the transmitter it was necessary to give careful attention to the fact that the steel drag rope,

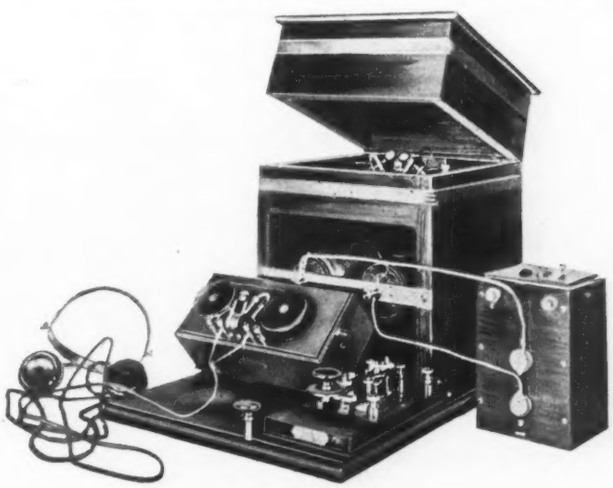


Fig. 2—Wireless Set.

which forms part of the open oscillating circuit, would be continually varying in length, dependent upon the lifting power of the hydrogen gas, thus causing a corresponding variation in its natural periodicity. A very loose coupling was finally determined upon in order to nullify as far as possible the effect of the open circuit upon the closed. The actual power used is approximately 250 watts, a standard Marconi 10-in. induction coil being used to charge the condenser. With this small amount of power the danger of troublesome sparking is

negligible, while actual tests with this set demonstrated the possibility of working from 50 to 75 miles without difficulty.

The Marconi Wireless Telegraph Company, contrary to its expectation, found no difficulty in obtaining an operator willing to make the trip, and from the many who offered themselves selected Mr. J. R. Irwin as being the one best fitted to perform the work. Mr. Irwin is undoubtedly looking for more laurels to add to those already attained from having received the famous "C.Q.D." message from the sinking *Republic*, while he was stationed at Siasconset. As an emergency auxiliary, Mr. Irwin is taking with him a large kite and a quantity of stranded copper wire, to be used as an aerial to be sent up from the life boat, should the necessity of launching it occur.

The airship *America* will send news bulletins to a New York newspaper, using the transatlantic steamships as retransmitting stations.

PRIME-MOVERS AT THE BRUSSELS EXPOSITION.

By Warren H. Miller.

THE most interesting mechanical display in the Brussels Exposition is the exhibit of locomobiles or superheated steam units in the German section. Both Heinrich Lanz, of Mannheim, and R. Wolf, of Magdeburg-Buckau, are well represented. The total exhibit takes up a large hall some 80 ft. x 200 ft., most of it occupied by the Lanz and Wolf engines. The feature of the exposition is a 1000-hp Lanz locomobile direct-connected to a direct-current dynamo which furnishes the greater part of the electricity used throughout the exposition. A 500-hp Wolf machine is belted to another generator running in parallel with it, and the energy from both is distributed through a large distribution board at the end of this hall. The construction of the Wolf superheated steam unit was described in the June 2 number. The Lanz machine has been running steadily without a hitch since the exposition opened, consuming 10½ lb. of steam per brake horse-power per hour at 375 deg. C. of superheat. The writer examined the engine carefully and made tachometer tests to obtain some idea of its usefulness when driving alternators connected in parallel. The speed of the unit was 260 r.p.m. and the tachometer needle showed absolutely no variation from this speed. Under such conditions there should be no hesitancy in using them for driving 60-cycle machines connected in parallel and, of course, none at 25 cycles. The company made numerous sales for 50-cycle work with belted alternators. The coupling of the dynamo, as well as of all the other parts, such as condenser, main engine, automatic firing equipment, etc., is a new feature, most locomobiles driving dynamos by belt. The valve-gear of the Lanz machines consists essentially of four balanced pop valves, mounted under the cylinder, so as to be self-draining, the two inlet valves being on one spindle and the two exhaust valves on a second spindle alongside of it. Both spindles are actuated by a rocking-cam which actuates the inlet valves alternately, and a second cam performs the same service for the exhaust valves. The type of valve employed requires very little movement to obtain full opening of the port, has no friction, so that it requires no lubrication and requires almost no power to actuate it, being balanced. With superheated steam at 375 deg. C., and pressures of nearly 200 lb., slide valves work under severe handicaps, if at all. This caused a demand for something that would not require lubrication and would withstand superheat, hence the growth of the Lanz gear. It is by no means new, the Stevens ferryboat engine valve in this country being a very close prototype.

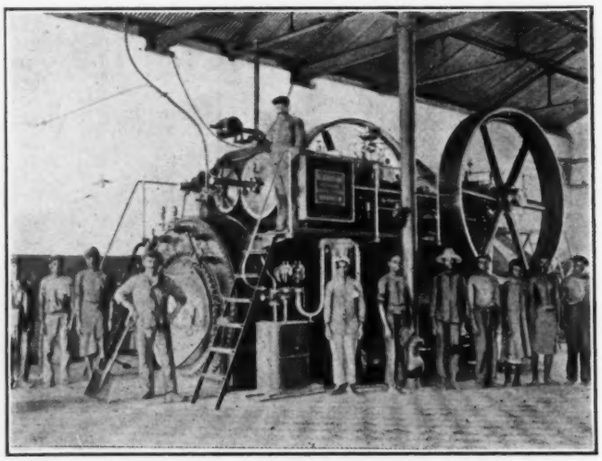


Fig. 2—Lanz Locomobile Engine.

Requiring but very little power to operate the valve, its spindle can be made correspondingly small, and the stuffing-box is of steel, into which the spindle is ground, making a 0.0001-in. fit. Labyrinthine packing rings cut on the spindle suffice to check steam leakage, and this device is used on all the engines equipped with pop-valves, including all the French and Belgian makes, as well as those of Krupp, in Germany, and Tosti, in Italy, in addition to its use on locomobile units.

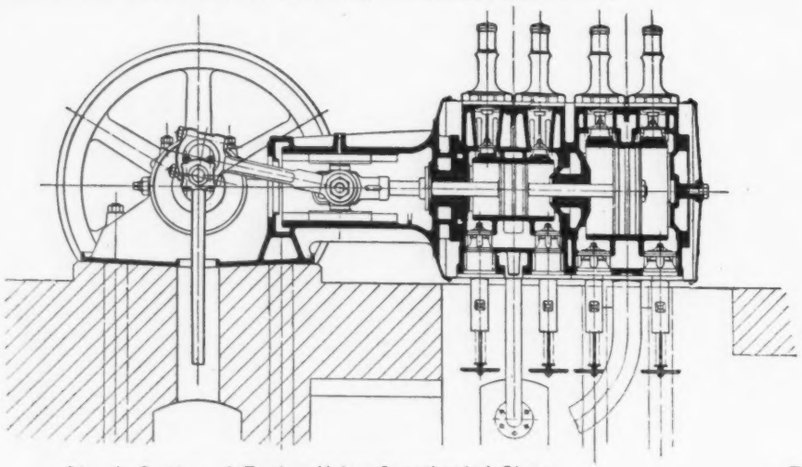


Fig. 1—Section of Engine Using Superheated Steam.

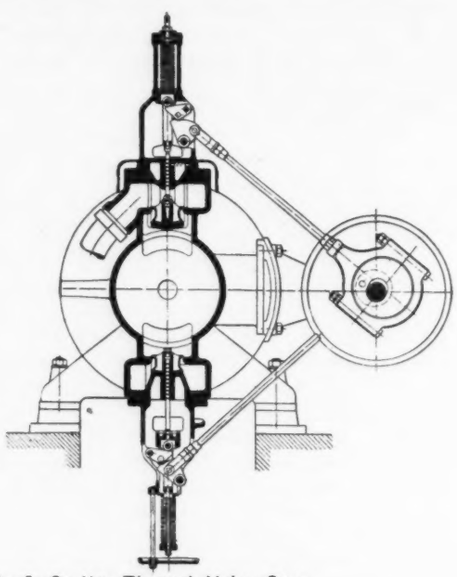


Fig. 3—Section Through Valve-Gear.

The Lanz 100-hp locomobile takes up about a floor-space of 20 by 30 ft., including the boiler. The latter is automatically fed with cheap, fine coal, without dust or dirt, so that the whole exhibit is surrounded with expensive mats and rugs. The apparatus is provided with an electrically driven condenser pump, which, although not quite as economical as the earlier mechanical pump driven by the engine, has the ad-

vantage that with electric energy available the condenser can be started ahead of the engine and also pump from a source lower than the condenser without filling the room with steam upon starting up. Americans are hardly as yet alive to the advantages of superheated steam in small units, from 1000-hp down to 75 hp, but units of this kind have become standard throughout Europe, the Far East, South America and the Indies. The locomotive exhibit in the same section is very fine, the Maffei locomotives of Munich deserving special notice by those interested in traction problems.

Another feature of interest to all electrical engineers engaged in industrial engineering is an electric traveling jib crane, serving the adjoining hall in the German section. At first blush it would hardly seem that a jib crane would have any place on an electrical traveler, as the two rectilinear motions cover the entire floor space, but it is the story of the gridiron city all over again. In practice the crane often stays in one restricted area for hours at a time, and every movement of stock in this space, even a 500-lb. casting, means moving the whole bridge. Now, if the bridge could be left alone and a jib swung under it the tool would be proportioned more nearly to the work and use far less energy accordingly. This crane, built by Bachem & Keelman, of Duisberg-on-Rhine, in Holland, gives this idea a practical embodiment. There is a light jib-crane, covering a circle of about 50 ft., mounted in the cage below the crane. It is integral with the "trolley" of the American traveling crane and moves across the bridge with it when wanted, but for ordinary service in moving stock within a limited range of 50 ft. the jib alone is used. For heavy loads of the full capacity of the bridge, the usual drum and sheave block are used.

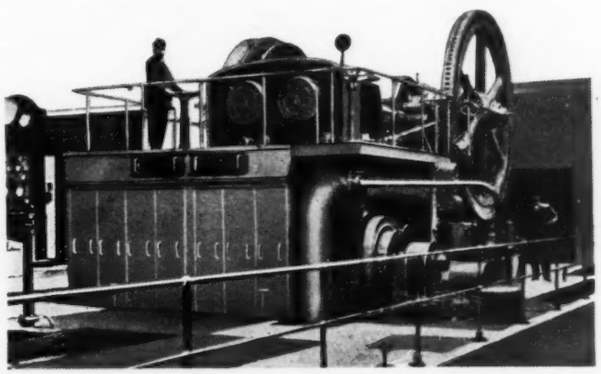


Fig. 4—Lanz Locomobile Engine, 1,000 hp.

In the International Machinery Hall are assembled most of the latest European developments in mechanical and electrical engineering. Except in the matter of machine tools America is not represented at all, and in machine tools only by a Belgian agent. Switzerland, Holland, Belgium and England are all well represented. Bollinckx, of Belgium, has three classes of engines on exhibition showing examples of his entirely steam-jacketed, Corliss, trip-gear engines with practically no waste clearance spaces and double-sleeve turned cylinder steam jackets for saturated steam, his Lenz system pop-valve geared engines for superheated steam in a tandem compound unit of 300 hp, and his new gas engine and producer, a 100-hp unit from the gas-engine works at Buyshingen, Belgium. Any one of these three types of prime movers is a study in correct logical thinking applied to the problem of getting a hp-hour of work out of a pound of coal under the specific conditions of each engine. Bollinckx considers any Corliss engine that requires more than 15 lb. of steam per hp-hour as a poor example of what can be gotten from ordinary saturated steam with due attention to good steam jacketing and elimination of clearance wastes. The Lenz-gear, driven from a lay-shaft with cams that deposit the valve on its seat without pound or jar and permits the use of highly superheated steam, with its resulting consumption of from 9 to 10 lb. of steam per brake horse-power-hour, is very similar to all the modern Belgian and French lift-valves which one sees so much of in present European practice. In Bollinckx's engines the inlet valves are plain pop valves, and the exhaust valves are of the piston type, because the exhaust is relatively cold. The engine shown in Fig. 1, and built by Zimmermann-Hanrez, of Monceau-sur-Sambre, Belgium, has a balanced lift valve in both inlet and exhaust, due most likely to the advantage of a short lift and invariable opening. It is rated at 550 nominal hp, 750 maximum, 125 r.p.m., 850 mm stroke, 150 lb. steam pressure. In all these valves the time of the lift is varied to give the proper cutoff by the governor, the valve always lifting to its full opening of about ¼ in. to avoid wire-drawing.

In the opposite bay is the exhibit of Brown, Boveri & Company, the famous Swiss firm of electrical constructors. They give full photographic details of their new 120,000-volt transmission now being installed in the Appenines in Italy and show one of the three-phase transformers; also some high-tension condensers and equipment for an electric axle lighting system.

The most striking exhibit in the main central bay is a 5000-hp, cross-connected gas engine which covers a floor-space about 40 ft. x 70 ft. Aside from a new system of ignition, however, and the size of all working parts, this unit presents little out of the ordinary in gas-engine design. It was built by the John Cockerill Company, of Antwerp, Belgium.

There is little else that is really new in this hall, full as it is with machinery by all the famous European manufacturers. In the Holland section is a steam-driven pump with the engine cross-head on its side, the main crank set horizontally, and the centrifugal pump at the bottom of a vertical shaft-well, inside of which was the revolving shaft held in suitable step bearings. This is an excellent device for pumping water economically from artesian wells, instead of a collection of compressed-air lifts in places where the water falls to some 20 ft. below normal level when pumping. In other respects the International Machinery Hall was filled with the usual assortment of engines, boilers, machine tools, electric apparatus, marine engines, portable steam engines, small locomotives, etc., none of them presenting anything much out of the usual. The exposition is strikingly similar to dozens of the same kind held in America and in the smaller cities of Europe.

SINGLE-PHASE COMMUTATOR MOTOR.

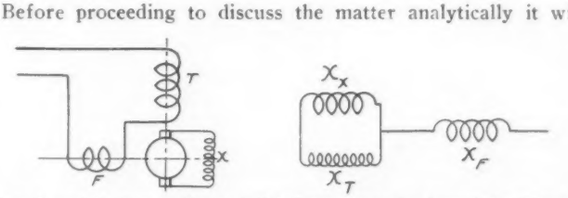
Effect of Extra Reactance in the Armature Circuit on the Performance of the Repulsion Motor.

BY SHIRO SANO.

IN the usual practice, the brushes of either simple or compensated repulsion motors are directly short-circuited, in order that no impeding effect shall be imposed on the short-circuiting current. However, it is interesting to see what effect, if any, will be produced by inserting an extra reactance, either inductive or condensive, into the circuit connecting the set of brushes, as is indicated in Fig. 1.

The primary winding of the motor can be considered to be composed of two parts, the transformer winding T and the field winding F, as is usually done in the treatment of this kind of motor.

Before proceeding to discuss the matter analytically it will be well to consider the fundamental nature of the effects which the extra reactance produces. In the first place, it will be seen that the extra reactance will not affect the time-phase relation of the current and the e.m.f. in the armature, for the armature winding proper will itself act as an inductance and the insertion



Figs. 1 and 2—Series Motor With Impedance in Armature Circuit.

ot the extra reactance will simply increase or decrease the whole reactance according to whether the latter is inductive or condensive reactance or capacity, and will simply decrease or increase the current in the armature without changing its time-phase relation with the e.m.f. In the second place, the appearance of an extra reactance outside the armature will cause a difference of potential between the brushes when any current exists in the circuit, where hitherto no e.m.f. was experienced when the brushes were dead short-circuited. The appearance of an e.m.f. between the brushes is simply a sure proof of the existence of a flux in the armature, the alternation of which is the real cause of the e.m.f. The above-mentioned flux will, in its course of alternation, create an e.m.f. in the transformer winding T, which will be proved below to be in time-phase with the field e.m.f. if the extra reactance is inductive and in time-phase opposition when it is condensive. Thus the insertion of an extra reactance will act in two-fold ways: to change the value of current without causing any change in its time-phase relation with e.m.f., and to create an extra e.m.f.

Since the transformer pole T and the armature act as a transformer, a little consideration will enable one to construct an equivalent circuit, corresponding to the above system, as indicated in Fig. 2, in which X_x stands for the extra reactance in the armature circuit reduced to primary terms, X_T for open-circuit reactance of the transformer coil, and X_F for the field-coil reactance. The combined reactance of the whole system will then become

$$\frac{X_T X_x}{X_x + X_T} + X_F = X_o \qquad (1)$$

If X_T be very large compared with X_x, the former can safely be neglected and the problem becomes much simplified. For this simplified case, if x is the actual value of the extra reactance, then the equivalent value in terms of the primary will be

$$X_x = (nm)^2 x, \qquad (2)$$

where n is the ratio of transformer to field circuit turns, and m the ratio of field circuit to armature effective turns. The total reactance for this simplified case will be, then,

$$X_o = X_x + X_F = (nm)^2 x + X_F. \qquad (3)$$

Since X_F is independent of the line current I, the extra reactance X_x may be represented in percentage of the former. Moreover, the extra reactance may be considered as a reactance put entirely outside of the motor, being connected in series therewith. This conception will simplify the whole problem. Let

$$X_x = tX_F. \qquad (4)$$

Then the total reactance becomes,

$$X_o = X_x + X_F = (1 + t)\, X_F. \qquad (5)$$

Proceeding as in the case of an ordinary simple repulsion motor, the transformer e.m.f. E_t will be found to be,

$$E_t = 2\pi f \Phi_t n m, \qquad (6)$$

and the field circuit e.m.f.,

$$E_f = 2\pi f \Phi_f m, \qquad (7)$$

where

f = frequency of supply current,
Φ_t = flux in transformer pole,
Φ_f = flux in field pole.

The e.m.f. generated in the armature by speed action by its cutting across the field flux, in its course of revolution, will be,

$$E_a = 2\pi f \Phi_f s, \qquad (8)$$

where s is the speed of the armature with synchronous speed as unity.

Now, let q be the ratio of extra to armature reactance, then the total reactance of the armature circuit will be,

$$X_a (1 + q). \qquad (9)$$

Where X_a is the reactance of the armature proper.

Now the total e.m.f. generated by speed action will be consumed partly in the armature winding and partly in the extra reactance. Since the consumption of e.m.f. will be proportional to the value of reactance, that part of the e.m.f. consumed in the armature proper will be represented by

$$E_a' = \frac{E_a}{1 + q} \qquad (10)$$

From transformer action, the e.m.f. in the transformer coil must have the value,

$$E_t = E_a' m n. \qquad (11)$$

Combining the preceding five equations,

$$\frac{\Phi_t}{\Phi_f} = \frac{s}{1 + q} \qquad (12)$$

Combining this again with (6) and (7),

$$E_t = \frac{n s}{1 + q} E_f \qquad (13)$$

It is proved in the theory of the ordinary simple repulsion motor that the transformer and field coil e.m.fs. are in time-quadrature with each other, and it can be proved also that the extra e.m.f. above stated is in time-phase with the field circuit e.m.f. The vector sum of the three must be equal to the line e.m.f. Hence,

$$E = \sqrt{E_t^2 + (E_f + E_f')^2}, \qquad (14)$$

where E_f' is the e.m.f. created by the extra flux above stated.

Considering the case where a unit current is sent through the system E_f will be the value of X_F, and hence the total impedance can be calculated from (5), (13) and (14), thus,

$$Z = \frac{X_F}{1 + q} \sqrt{(n s)^2 + (1 + q)^2 (1 + t)^2}. \qquad (15)$$

Now, t and q in above equation are not independent of each other.

From (2) and (5),

$$X_x = (n m)^2 x = tX_F,$$

and from (10)

$$x = qX_a.$$

Hence,

$$(n m)^2 q = \frac{tX_F}{X_a}$$

But $\frac{X_F}{X_a} = m^2$ for equal magnetic reluctance in both axes.

From which

$$t = n^2 q. \qquad (16)$$

Substituting this value in (15),

$$Z = \frac{X_F}{1 + q} \sqrt{(n s)^2 + (1 + q)^2 (1 + n^2 q)^2} = \frac{X_F}{1 + q} K \qquad (17)$$

K being a constant.

The primary current may be found by dividing the line e.m.f. by the impedance, thus,

$$I = \frac{E (1 + q)}{X_F K} \qquad (18)$$

Now, since the line current is in time-quadrature with the field circuit e.m.f., including the extra e.m.f. above mentioned, and the latter is in time-quadrature with the transformer e.m.f., the field e.m.f. may be taken as an equivalent reactance e.m.f. and the transformer e.m.f. as an equivalent resistance e.m.f. Then the power-factor may be obtained by dividing the equivalent resistance e.m.f. by the total e.m.f., thus,

$$\cos \Theta = \frac{n s}{K} \qquad (19)$$

Power input is

$$P = \frac{E^2 n s (1 + q)}{X_F K^2} \qquad (20)$$

Torque is

$$D = \frac{P}{s} = I^2 n \frac{X_F}{1 + q} \qquad (21)$$

The ratio of the starting torque to the torque at synchronous speed is then

$$\frac{D_o}{D_1} = 1 + \left[\frac{n}{(1 + q)(1 + n^2 q)}\right]^2 \qquad (22)$$

The effect of the extra reactance will best be seen by citing a numerical example. Consider the case where $n = 3$, $q = \pm 0.05$; that is, let the extra reactance inserted be 5 per cent of that of the armature proper. The positive sign refers to the inductive reactance, while the negative sign stands for condensive reactance.

Taking X_F as unity the impedance formulas for this particular case become:

$Z = 0.954\sqrt{9s^2 + 2.32}$ for $q = +0.05$.

$Z = 1.05\sqrt{9s^2 + 0.274}$ for $q = -0.05$.

$Z = \sqrt{9s^2 + 1}$ for $q = 0.0$.

The primary current, the power-factor, and the torque for different values of s have been computed and plotted as curves in Fig. 3.

It will be seen from these curves that the insertion of an extra inductive reactance in the armature circuit will give a

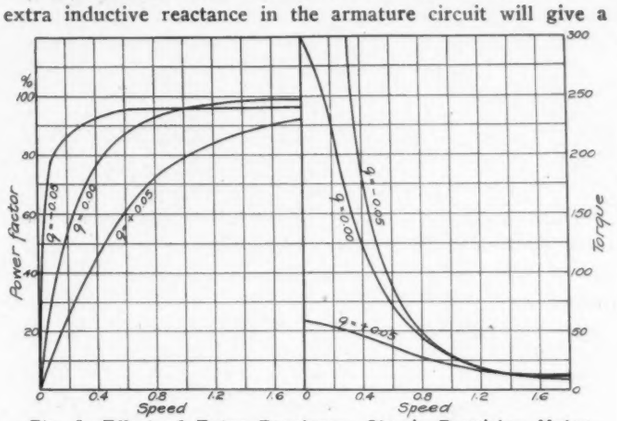


Fig. 3—Effect of Extra Reactance, Simple Repulsion Motor.

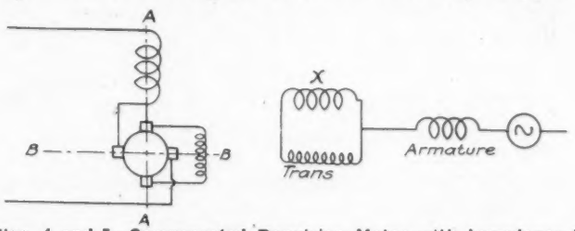
poorer power-factor at any speed than that of the ordinary motor, while the insertion of a condensive reactance improves the power-factor decidedly at lower speed, but it soon becomes "saturated," so to speak, and reaches a practically constant value which is lower than that of the plain motor after the speed exceeds a certain value which happens to be near synchronous speed for a low value of q. The starting torque for the case of the inductive reactance is very much smaller than that for the plain motor, whereas if condensive reactance is inserted it will be enormously greater. When the speed exceeds a certain value, however, the torque will be practically the same for the three cases.

From these results it will be seen that the insertion of an extra inductive reactance in the armature circuit will make matters worse, while condensive reactance will improve the performance. So much for the simple repulsion motor.

EFFECTS ON COMPENSATED MOTOR.

Consider now the case of the compensated repulsion motor with an extra reactance in the armature circuit (Fig. 4).

By the same reasoning as in the case of the simple repulsion



Figs. 4 and 5—Compensated Repulsion Motor with Impedance in Armature Circuit.

motor, the equivalent circuit for this case may be represented as in Fig. 5. By the same method as was used in the case of the simple repulsion motor, one may show that there are three different fluxes to be considered in this motor, namely:

Φ_t' created along AA by the line current (Fig. 4).

Φ_f created along BB by the line current.

Φ_t created along AA by the armature generator current.

Of these Φ_f and Φ_t' are in time-phase, while the third is in time-quadrature with them (Fig. 6).

Since these three fluxes alternate there must be three different e.m.fs. induced by the rate of change of these. Moreover, since the armature revolves, there are expected three more e.m.fs. generated in the armature by speed action. Thus one must deal with a total of six different e.m.fs. The relative time-phase positions of these are as shown in Fig. 7. It is not intended, in this figure, however, to show the exact phase relations of these six e.m.fs., but simply aid the memory by showing which of these are in quadrature with one another. That is, it is not known as yet whether two e.m.fs. are in time-phase or in phase opposition, but merely aware that the two are in line with each other.

Let x = extra reactance in armature circuit,

n = ratio of transformer to armature effective turns,

X = stationary armature reactance.

Then the extra reactance reduced to primary terms will be

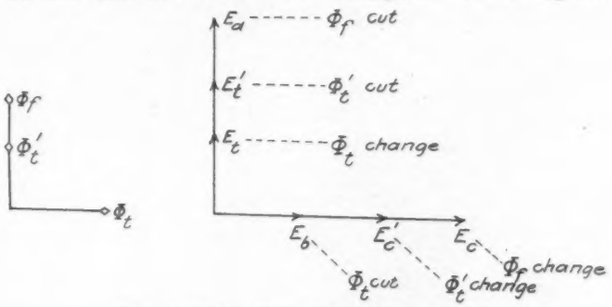
$$X_x = n^2 x. \tag{23}$$

Let $X_x = t X$,

and $x = q X$,

then $t = n^2 q$. (24)

The last relation is based on the assumption that the magnetic



Figs. 6 and 7—Flux and Voltage Vectors.

reluctances of AA and BB are the same. The extra reactance in terms of primary then becomes,

$$X_x = n^2 q X. \tag{25}$$

This reactance, after all, appears as the reactance of the transformer coil. Since the line current passes the transformer coil and the armature at the same time, the voltage drop in the two will be, respectively,

$$E_c' = I n^2 q X,$$

$$E_c = I X.$$

Also from induction,

$$E_c' = 2\pi f n \Phi_t',$$

and

$$E_c = 2\pi f \Phi_f.$$

From these equations,

$$\frac{E_c'}{E_c} = n^2 q = n \frac{\Phi_t'}{\Phi_f}$$

Hence,

$$\frac{\Phi_t'}{\Phi_f} = n\ q \tag{26}$$

Now E_d is proportional to Φ_f and the speed, while E_t' is proportional to Φ_t' and the speed. The speed in the two cases being identical, there is obtained the relation:

$$\frac{E_t'}{E_d} = \frac{\Phi_t'}{\Phi_f} = n\,q. \tag{27}$$

Thus

$$E_t' = q\,(1+q)\,E_t, \tag{28}$$

and

$$E_c' = n^2 q E_c. \tag{29}$$

E_c' is evidently in time-phase with E_c, so also is E_t' with E_t. Thus finally:

Total reactive voltage,

$$E_c + E_c' - E_b. \tag{30}$$

Total resistance voltage,

$$E_t + E_t'. \tag{31}$$

Now the e.m.f. along BB, induced by the rate of change of the field flux, may be represented by

$$E_c = C f \Phi_f,$$

where C is the number of conductors on the armature.

The e.m.f. along AA generated by speed action due to cutting across the field flux by the armature conductors will be

$$E_d = C \Phi_f V.$$

The counter e.m.f. induced in the armature by the rate of change of the transformer flux is

$$E_a' = C f \Phi_t.$$

The total e.m.f. E_d is consumed partly in the armature and partly in the outside reactance. Since q is the ratio of extra to armature reactance, the total reactance of the circuit along AA will be

$$X (1+q). \tag{32}$$

Now

$$E_a' = \frac{E_d}{1+q} \tag{33}$$

Hence, from preceding equations, we have,

$$\Phi_t = \frac{s \Phi_f}{1+q} \tag{34}$$

Here one must give a different interpretation to the term synchronous speed. With an ordinary motor the synchronous speed is defined as the speed at which Φ_t becomes equal to Φ_f. However, in this motor, it seems to the author to be best to define it as not the speed at which the two fluxes attain the same value actually, but the speed which would give this relation if there were no extra reactance.

From transformer relation it is found that

$$E_t = n E_d' = n \frac{E_d}{1+q} \tag{35}$$

Hence

$$E_t = s E_c \frac{n}{1+q}$$

The e.m.f. generated along BB by speed action by the cutting of the transformer flux is

$$E_b = C \Phi_t s f,$$

hence

$$E_b = s E_d' = s \frac{E_d}{1+q} \tag{36}$$

Now let

$$E_c = X,$$

then

$$E_t = X \frac{ns}{1+q} \tag{37}$$

and

$$E_b = X \frac{s^2}{1+q} \tag{38}$$

Finally, the total reactance becomes

$$X \left(1 + n^2 q - \frac{s^2}{1+q}\right) \tag{39}$$

and the total apparent resistance

$$R = n s X \left(q + \frac{1}{1+q}\right) \tag{40}$$

Hence, the apparent impedance of the whole system will be

$$Z = X \sqrt{\left(1 + n^2 q - \frac{s^2}{1+q}\right)^2 + \left\{\left(q + \frac{1}{1+q}\right) n s\right\}^2}$$
$$= X K'. \tag{41}$$

Power-factor is then

$$\cos \Theta = \frac{R}{Z} \tag{42}$$

Primary current

$$I = \frac{E}{XK'} \tag{43}$$

Power input

$$P = E I \cos \Theta. \tag{44}$$

Torque

$$D = \frac{P}{s} \tag{45}$$

By looking closely into the equation expressing the power-factor it will be noted that the power-factor can be improved at low speed by making q negative, that is, by inserting a condensive reactance in the armature circuit, but that if the negative value of q becomes too large the power-factor will not reach unity. The critical point which determines whether or not the power factor reaches unity may now be discussed. By examining equation (42) it will be seen that to make the power-factor unity one must put

$$1 + n^2 q - \frac{s^2}{1+q} = 0.$$

That is,

$$s^2 = n^2 q^2 (1+n^2) q + 1. \tag{46}$$

The right-hand term must be greater than zero to make s real, or the critical point is when this is nil. Equating this to zero, therefore, we have

$$q = \frac{-(1+n^2) \pm \sqrt{(1+n^2)^2 - 4n^2}}{2n^2} \tag{47}$$

For example, for $n = 3$ the value of q becomes -0.111. Hence, q must be smaller (in its absolute value) than 0.111 for the power-factor to reach unity.

THE SECONDARY CURRENT.

The current induced by speed action by the cutting of the field flux is proportional to Φ_f and the speed, hence

$$I_d = K'' \Phi_f s,$$

where K'' is a constant.

The field flux may be taken as proportional to the main current; hence,

$$I_d = k I s.$$

Now, it is clear that to have Φ_t equal Φ_f, I_d must be equal to I, and this occurs not when $s = 1$, but when $s = 1 + q$. Hence

$$I = k I (1+q), \tag{48}$$

whence

$$k = \frac{1}{1+q},$$

and therefore

$$I_d = \frac{I s}{1+q} \tag{49}$$

There is another current in time-quadrature with this, which is the current produced by the transformer action of the trans-

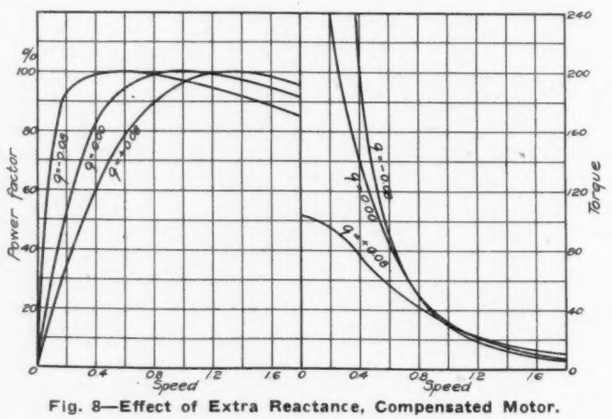


Fig. 8—Effect of Extra Reactance, Compensated Motor.

former coil, the value of which is $I_2 = n I$. Hence, the total current along AA becomes

$$\sqrt{I_2^2 + I_d^2} = I \sqrt{n^2 + \left(\frac{s}{1+q}\right)^2} \tag{50}$$

To show the effect of the extra reactance more lucidly there is shown herewith a numerical example of a motor in which $n = 3$, and $q = -0.08$, or 0.0 or $+0.08$, curves being plotted for the power-factor and the torque, as shown in Fig. 8.

It will be seen from these curves that the point of unity power-factor shifts with the change in the value of q. For $q = 0$, it occurs at $s = 1$; for the positive value of q it occurs at a higher speed, whereas for the negative value at a lower speed than $s = 1$.

The starting torque for the negative value of q becomes enormously large, while that for the positive value much smaller than that for $q = 0$. Above synchronous speed, however, the three torques become practically equal.

EFFECT OF BRUSH SHIFTING.

So far it has been assumed that the axis of the short-circuiting brushes coincides with the axis AA. It is interesting to see, however, what occurs when the axis is shifted from the usual position.

In a vast majority of compound events the total effect produced by the complex combination of events can be considered as a sum or product of two or more simple events. So also in this case one may consider the brush-shifting and the insertion of extra reactance separately and combine the two later if it is so desired. In what follows will be considered the action of brush shifting without any extra reactance in the armature circuit. This plan will simplify the case enormously.

A little reflection will convince one that the effect of brush shifting is equivalent in its action to a change in the number of field circuit turns, and in effect will be the compromise between purely compensated and the simple repulsion motor. The field flux produced by this equivalent field turns is either directly in time-phase or in time-phase opposition to that produced by the armature, according to the direction of shifting.

Let E_c' be the e.m.f. generated by the rate of change of Φ_f in the armature and E_c'' that smilarly generated in the field turns. Then,

$$E_c' = c\, f\, \Phi_f,$$

as before, and

$$E_c'' = \pm m\, E_c',$$

where m is the ratio of field circuit to armature effective turns. The total reactance e.m.f. will then be, at standstill,

$$E_c = E_c' \pm E_c'' = c\, f\, \Phi_f\, (1 \pm m). \qquad (51)$$

It was found that

$$E_b = s^2\, c\, f \Phi_f.$$

Hence the total reactive e.m.f. at speed s is

$$E_c = E_c' \pm E_c'' - E_b = c\, f\, \Phi_f\, (1 - s^2 \pm m) \qquad (52)$$

At unit current E_c' may be regarded as the stationary reactance of the armature, X, so that the above equation becomes

$$X\, (1 - s^2 \pm m). \qquad (53)$$

It was found also that the equivalent resistance is

$$R = n\, s\, X. \qquad (54)$$

The combined impedance at speed s is, therefore,

$$Z = X\sqrt{(n\, s)^2 + (1 - s^2 \pm m)^2}, \qquad (55)$$

and the power-factor is

$$\cos \Theta = \frac{R}{Z} \qquad (56)$$

line current is

$$I = \frac{E}{Z} \qquad (57)$$

power input

$$P = E\, I \cos \Theta, \qquad (58)$$

torque

$$D = \frac{P}{s} = I^2 n\, X. \qquad (59)$$

The ratio of transformer to field turns is

$$q = \frac{n}{m} \qquad (60)$$

Since q is the ratio of the two turns it has the value

$$q = N \cos \alpha / N \sin \alpha = \cot \alpha,$$

where N is the actual number of turns of the stator and α is the angle of brush shift. From (60) it will be seen that

$$n^2 + m^2 = n_0^2,$$

and

$$n = \frac{n_0\, q}{\sqrt{1 + q^2}} \qquad (61)$$

$$m = \frac{\pm n_0}{\sqrt{1 + q^2}} \qquad (62)$$

where n_0 is the ratio of actual number of turns of the stator to effective armature turns.

The various values of α for different values of q are:

q	3 5	3.0	2.5	2.0	1.5	1.0
α	16°	18.5°	21.75°	26.5°	33.75°	45°

A numerical example of a motor in which $n_0 = 3$ is presented in Fig. 9. In this example α is taken as -16 deg., 0 deg., and $+16$ deg. for a two-pole machine.

It will be seen from these curves that the shifting of the brushes in a negative direction will shift the point of unity power-factor to below synchronous speed, while the shifting of the brushes in the other direction will shift the point

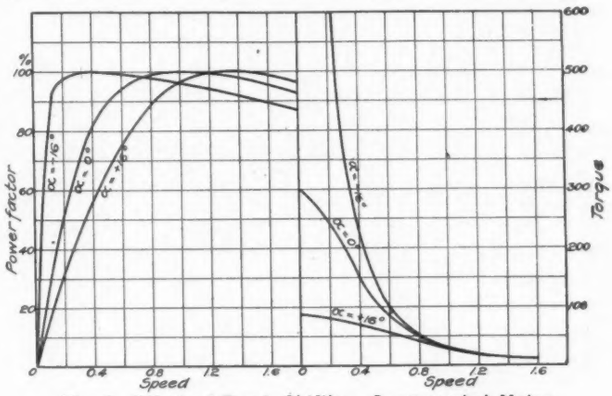


Fig. 9—Effect of Brush Shifting, Compensated Motor.

away from the synchronous speed to a higher speed. Again, the negative shifting results in an enormous starting torque, whereas the positive shifting decreases the starting torque to a much smaller value than that for $\alpha = 0$. Above synchronous speed, however, the three torques have practically the same value.

In conclusion it may be remarked that the brush shifting of the compensated motor is very much analogous to the introduction of extra reactance in the armature circuit.

In the treatment of the entire subject the author neglected the existence of ohmic resistance and the leakage reactance in any part of the motor, since the consideration of these factors would complicate the whole subject to an unnecessary degree.

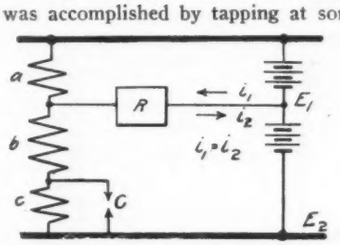
Waseda University, Tokyo, Japan.

A NETWORK PROBLEM.

BY NICHOLAS STAHL.

A rather interesting application of the network problem occurred recently in conection with a patent application in which, as indicated in the diagram, it became necessary to cause an assigned current to flow through a given resistance (magnet) first in one direction and then reversed.

This result was accomplished by tapping at some convenient



Arrangement of Circuit Connections.

point a battery or bank of lamps or point in a resistance coil. The lead, passing through the magnet in question, taps a point in a resistance circuit between buses connecting the two sources of e.m.f. The second point is alternately, by a predetermined potential difference, below and above the first tap point, reversal being effected automatically by short-circuiting a portion of the resistance circuit by means of a contact-making device, indicated at C, by a suitable instrument actuated from the fluctuating source involved. Reckoning potential differences from one end of the battery, assumed zero, let E_1 be that of the first tap point and E_2 that for the other bus; a, b and c are the re-

sistances in the circuit. Second tap point is assumed first at potential V_1, and later at V_2

or $$E_1 - V_1 = Ri = V_2 - E_2, \quad (1)$$

where i is the reversible current through the resistance R.

If x be the current in b and c in the first case, and y that in b in the second case, by applying Kirchhoff's laws, one obtains Case 1:

$$V_1 = a\,(x + i) \quad (2)$$

$$E_2 - V_1 = (b + c)\,x \quad (3)$$

Case 2:

$$V_2 = a\,(y - i) \quad (4)$$

$$E_2 - V_2 = by \quad (5)$$

and, otherwise expressing the initial relation,

$$V_1 + V_2 = 2E_1. \quad (6)$$

These are the only independent equations; Kirchhoff's laws for the outside circuit give merely the sum of (2) and (3) for case No. 1 and (4) and (5) for the other.

It will be observed that these five equations contain 10 quantities, so that five must be given arbitrary values to effect a solution. E_2 is, of course, known or decidable, i follows from the conditions of desired operation. From equation (4) it is seen that y must be greater than i to keep within the physical limitations of the problem. Moreover, inasmuch as the contact-making device has to break the current y, this current should be as small as possible, which conditions y, but does not fix it, as y and i are not independent.

Since it is desirable to waste as little power as need be in I^2R losses, one at least of the quantities a, b and c should be large, which is secured in effect by making V_1 and V_2 of relatively largely different values.

Inasmuch as all the quantities are essentially positive, equation (2) places an upper limit on a, for example:

$$x = \frac{V_1}{a} - i, \text{ and since } x > o,$$

$$\frac{V_1}{a} > i$$

or, on the assumption shortly to be made of $i = 0.5$,

$$a < 2V_1.$$

Assume now

$$E_2 = 125;\ V_1 = 80;\ V_2 = 120;\ i = 0.5;\ a = 150.$$

Then by algebra,

$$x = 0.035 \text{ amp.} \quad y = 1.3 \text{ amp.} \quad E_1 = 100 \text{ volts.}$$

$$b = 3.85 \text{ and } c = 1281.15 \text{ ohms.}$$

As a typical electrical problem, citation is made in detail to bring out three points: the determination of certain quantities (the currents x and y), as of definite (small) values, is essential to successful mechanical operation of the principle (contact-making device); the avoidance of assigning arbitrary values to quantities interdependent; prognosis of physical limitation on quantities mathematically independent. Further, the labor of calculating maxima or minima is avoided by a little preliminary inspection.

Central Station

Management, Policies and Commercial Methods

PRIZES FOR SUGGESTIONS FOR IMPROVED SERVICE.

The Commonwealth Edison Company of Chicago makes a practice of offering a prize of $1 to any employee who submits a useful suggestion for the betterment of the service or of the manner of doing business. Many suggestions are received in consequence of this offer, and although a considerable proportion relate to rather unimportant details there remains a number of some value, and for these prizes are awarded. The company also offers a prize of $1 for every mistake discovered by any employee in the company's advertising matter. These prizes also excite much interest. They have a double value, for not only is the advertising matter prepared with especial care in consequence, but all employees of the company are pretty sure to read its advertisements to see if they can detect an error which will bring them in the dollar reward. By reading the "ads" carefully, the employees are kept in constant touch with the company's efforts to reach the public.

MAINTENANCE OF METERS IN SMALL PLANTS.

Mr. A. M. Richardson, of Ann Arbor, Mich., read a paper on the maintenance of meters before the Michigan Electric Association convention, at Port Huron, on Aug. 18, 1910. He took up first the increased necessity for accuracy of meters, now that tungsten lamps with low specific consumption are coming into use. A few years ago there was almost a different type of meter for every customer. To-day there are three meters in general use, all with the same constant, the meters differing only in repair parts. Not only have the makers produced a simple, easily-adjusted meter, but they have provided in the rotating standard a simple and inexpensive means of testing. The rotating standard has robbed meter testing of complication, and of many possible sources of error, and has greatly reduced the expense. While formerly several instruments and a couple of men were required to test a meter, thereby making the occasion quite a social event, to-day a more reliable job is done by one man by the use of a rotating standard.

The first essential of a system of keeping meters accurate is a certain definite part of a certain definite man's time. The work is essentially that of a specialist, and should with all other meter work be concentrated in one man's hands, thereby enabling him to get all the experience possible, and fixing the responsibility. His main possession should be: experience, intelligence, interest in the work, reliability and good standing in the community. The second essential is the headquarters for this department. A room must be set aside for the purpose of storing and testing meters. For checking the test meter an indicating wattmeter is probably the usual equipment, although every batch of new meters from the factory affords a rough check. Arrangements can possibly be made with a larger company for checking the test meter, or it can be sent back to the factory or a test bureau.

One inexpensive scheme is to mount on the test board an ordinary meter that has tested out perfect, and thereafter use it for the sole purpose of checking the test instrument. The question of extreme accuracy need not be considered at the present time, when all available data indicates that outstanding meters average 8 per cent slow. A meter found on test within 1 per cent of perfect should be left alone. In testing a meter a portable loading device will be required, as it saves much running about on the customer's premises. This device consists of a box containing lamps, flatiron units, or similar non-inductive load, so wired up to switches that any load from that of a 2-cp lamp to 25 amp can readily be obtained. Suitable printed forms must be provided for recording the results of the tests, using stiff paper to allow writing when held in the hand, and for vertical filing. Meter readers appreciate having meters in convenient locations. Meter testers appreciate this still more, and the quality of the meter testers' work will depend very much on the convenient location of the meters which he has to test.

The consumer's connected load is sometimes changed, and it is the duty of the meter tester to note this, and order a suitable

change in meters. It seems a general and good practice to install meter equipment for 60 per cent of the residence connected load, and 100 per cent of the business load, using no single meter, however, under 5 amp, or over 50 amp rating. Where the load is greater than 50 amp use should be made of a 5-amp meter and suitable series transformers, thereby allowing testing with ordinary equipments.

At Ann Arbor there are only two makes of meters and no meter is more than five years old. In the last five years each meter has had at least one shop test and two installation tests. With 2000 meters, one man's time is given up entirely to setting, removing and testing meters, making all special meter readings, and doing the heavy work at regular meter reading times. Most of the testing work is done during the first three months of the year when the other work is slack. The labor cost of testing a meter under these conditions is 25 cents, and is the main expense, as supplies and repair parts are almost insignificant.

DEMAND AND DIVERSITY FACTORS AND THEIR INFLUENCE ON RATES.

By J. R. Cravath.

DEMAND factor is defined as the highest percentage of connected load which is ordinarily in circuit. Thus, if a central-station consumer has 10 kw in lamps connected and his highest maximum demand is 5 kw, he would be rated as having a demand factor of 50 per cent.

Diversity factor is commonly defined as the ratio of the sum of the maximum demands of a given group of consumers at different times to the actual maximum demand made by the group at one time. This likewise frequently can best be expressed in per cent. For example, a group of 10 consumers connected on a certain secondary main might cause a maximum demand of 3 kw on the transformer supplying that main; but if a maximum-demand meter were installed on each consumer's service the sum of the maximum demands recorded by these meters for any month might be 9 kw in certain classes of work. Expressed in per cent, the diversity factor of this load in relation to the transformer would be 33.33. This difference between the sum of the individual maximum demands of each consumer and the actual maximum demand on the transformer is, of course, caused by the fact that the maximum demands of the various consumers do not occur at the same time. In other words, there is diversity in time of maximum demand.

The existence of diversity and demand factors in central-station business has been recognized since the earliest days, although it is only recently that these brief terms have come into use to express these relations. It may also be said that although the central-station industry has been dependent for its very existence on diversity and demand factors, the study of these factors has not been as thorough as it should have been. It is only recently that much activity has been shown in the study of these factors, which have an all-important influence on the rates that central-station companies can afford to make, and hence are at the very foundation of the industry. The reason of their importance is that so large a percentage of the cost of supplying electric service is frequently made up of certain fixed charges, such as interest, depreciation and taxes, which are brought about by the necessity of providing a certain investment to take care of a certain connected load. It is evident that the larger the amount of apparatus required to supply 1 kw of connected load the greater must be the fixed charges per kilowatt connected.

The percentage of the cost of serving a consumer which is due to fixed charges and the percentage due to variable operating expenses differ according to the class of consumer. The fixed charges are seldom less than 10 per cent and may be as high as 100 per cent of the cost of service. The fewer the hours per year the service is used the greater the percentage cost composed of fixed charges. For example, if a certain consumer contracts for electric service and the company installs meters, lines, generating capacity, etc., to supply him, and if that consumer uses no electrical energy whatever during the year, the cost of serving him evidently is made up entirely of fixed charges on the investment required, plus a small amount for keeping books, reading the meter and maintaining the office. If, on the other hand, the consumer used his entire connected load 8760 hours in a year, his fixed charges should be divided into 8760 parts to determine the amount a kw-hour. The great majority of central-station customers, however, use the service but a limited number of hours a year.

The relative proportion of total expenses chargeable to the three heads—fixed, operating and consumers' charges—has been a matter of considerable investigation. It is not likely to be exactly the same for any two plants. It is of interest, however, to cite a few examples from various recent published investigations. A very thorough investigation of this division of expenses was made by the Wisconsin commission in the recent Madison Gas & Electric Company case, decided March 8, 1910. For the year 1908 the commission found by one method of analysis that 16.7 per cent of the total cost was caused by the expenses which are the same for each consumer, entitled "consumer expenses"; 21.6 per cent were expenses proportional to the demands of each consumer, and 61.7 per cent were variable operating expenses proportional to the kw-hours' output. By another method of analysis 58.2 per cent of the expenses were chargeable to output, being proportional to kw-hours, and 41.8 per cent were chargeable to demand. In the case of the Ripon Light & Water Company, decided March 28, 1910, the Wisconsin commission assigned about 39 per cent to capacity charges and 61 per cent to output charges.

In a paper before the last N. E. L. A. convention Mr. S. E. Doane gave the results of central-station cost analysis from 70 small central stations in the East, 40 small central stations in the West and two very large central stations. In this analysis it appeared that of the total cost 30.3 per cent was proportional to output, 55.1 per cent proportional to demand, and 14.6 per cent proportional to the number of consumers.

In a paper before the Missouri Electric, Gas, Street Railway and Water Association, in April, 1909, Mr. C. W. Hough gave an analysis of the cost of central-station service, taking as a basis the statistics given by the last United States census report on the electrical industry. He reached the conclusion that the total cost should be divided into consumer charges, 5 per cent; capacity charge, 35 per cent, and output charge, 60 per cent. These, Mr. Hough said, represented the average results as shown by the Government reports. The proportions chargeable to the various items should, of course, be investigated for each individual company, rather than taken from general averages, when any specific case is being investigated with a view to adjusting rates. The figures given are of interest merely as showing what figures have been obtained in some cases. If it is assumed that at least 30 per cent to 40 per cent of the average cost of serving consumers, and perhaps more, is caused by the maximum demand of such consumers, the importance of determining what actual maximum demand these consumers put upon the station is evidently important.

It is an easy matter to determine the ratio of total connected load to maximum demand on the central station where the company has a connected load of record. However, the determination of this ratio and the determination of the percentage of the total cost chargeable to fixed expenses is by no means sufficient to afford a basis for rates. In other words, averages are worth little when the character of service required by various consumers differs so greatly. The attempt must be made to determine as nearly as possible the actual demand and diversity factors of different kinds of loads in order that the central-station management may know what proportion of the fixed investment charges must be carried by these different kinds. If this is not done some profitable business is likely to be lost for lack of a proper rate schedule, while other unprofitable business is obtained.

There are a number of links in the chain between the consumer's lamps and the generators at the power plant. First, the demand factor or ratio of connected load to maximum de-

mand must be studied at each consumer's premises and then the diversity factors at different points between the consumer and the power plant.

Beginning at the consumer's end, the first step is to determine the demand factor or the ratio of the consumer's maximum demand to his connected load. This determines the size of meter and service wires necessary and the consequent investment. Next, in an alternating-current system, comes the diversity factor between the various consumers and transformers, which indicates the transformer capacity necessary to serve a given kind of connected load. Next is the diversity between different kinds of load whose maximum demands occur at different times. If the system is direct current, of course the transformers are omitted and the diversity factor must be taken from the consumers' services to the ends of the feeders supplying the various mains.

This subject has not been studied enough so that many figures cannot be given on the demand and diversity factors of various classes of service and the diversity factor between these classes. A compilation of some of the available figures, however, will be given in the hope of stimulating further interest in this important subject.

DEMAND FACTORS.

The Wisconsin Railroad Commission has probably carried on one of the most comprehensive series of investigations yet made to determine this demand factor or ratio of maximum demand to connected load for various classes of consumers. This commission in the case of the Ripon Light & Water Company formulated certain rates. In formulating these rates it was necessary to assume certain figures for demand factors of various consumers. These figures as fixed by the commission were based on data from a large number of other cities, but also took into account local conditions. These figures were as shown in Table I:

TABLE I.—DEMAND FACTORS ASSUMED AS BASIS OF RIPON RATES BY WISCONSIN COMMISSION IN PER CENT.

Residences, flat and rooming houses	40
Public buildings	40
Ripon College	20
Schools and churches	55
Factories	55
Hotels	60
Livery stables	60
Libraries	60
Stores	75
Offices	75
Banks	75
Saloons	75
Depots	75
Theaters	75
Club rooms	75
Electric signs	100
Hallways	100
Street lamps	100

The same commission when fixing the rates for Madison, by decision rendered March 8, 1910, specified that in figuring rates for Madison, the following demand factors should be used, as shown in Table II:

TABLE II.—DEMAND FACTOR ASSUMED BY WISCONSIN COMMISSION FOR FIXING RATE AT MADISON IN PER CENT.

Residence lighting, first 10 lamps	60
Residence lighting over 10 lamps or 500 watts	33.3
Stores and offices	70
Restaurants and saloons	70
Lodge and dance halls	70
Laundries	70
Depots	70
Theaters	70
Hall lamps	70
Factories	55
Livery stables	55
Churches	55
Hotels and clubs	55
Schools	55
County and federal building	55
University of Wisconsin	30
Sign and outline lighting	100
One motor under 10 hp	90
10 hp installation with more than one motor	80
Motor installations with more than 10 and less than 20 hp	70
Motor installations 20 to 50 hp	60
Motor installations 50 to 100 hp	55
Motor installations 100 hp or over	50

The Wisconsin commission has also collected data from a number of large companies using Wright demand meters by which it is possible to know the actual maximum demand of each consumer. The demand factors obtained from these companies which use maximum-demand meters vary considerably, as will be seen by Table III, which gives the highest and lowest figures reported for various classes of business.

TABLE III.—DEMAND FACTOR COMPILED BY WISCONSIN COMMISSION FROM COMPANIES USING WRIGHT DEMAND METERS.

Stores	40 to 100
Offices	57 to 87
Saloons	62 to 92
Restaurants	52 to 62
Factories	53 to 56
Churches	56 to 85
Hotels	28
Clubs	28
Schools	37 to 52
Laundries	60 to 75
Livery stables	52 to 58
Lodge and dance halls	68
Depots	75 to 95
Theaters	49 to 89
Shops	55
Machine shops	37 to 54
Blacksmith shops	66
County and federal bldg.	33 to 31

The Commonwealth Edison Company of Chicago has given considerable study to this matter of demand factors, and many figures covering different classes of consumers can be found in two papers presented by representatives of that company at the National Electric Light Association conventions. One of these, entitled "Load Factors," was presented by Mr. E. W. Lloyd at the 1909 convention. Another, entitled "Significance of Statistics," was presented by Messrs. George A. McKana and B. F. McGuire at the 1910 convention. In the latter paper demand factors for the month of January, 1910, for small and medium lighting customers summarized were as shown in Table IV:

TABLE IV.—DEMAND FACTORS—CHICAGO LIGHTING CUSTOMERS.

Offices of various kinds	72.4
Residences and barns	60
Retail stores	66.3
Wholesale stores	70.1
Billboards, monuments and department stores	85.6
Average	59.8

A similar table was given for the motor users of the company in the direct-current territory where Wright demand meters are used on each consumer's service. These showed demand factors as shown in Table V.

TABLE V—DEMAND FACTORS—CHICAGO MOTOR CUSTOMERS.

Public gathering places and hotels	28.7
Offices	65.1
Residences and barns	69.3
Retail stores	61.2
Wholesale houses and shops	58.2
Average	59.4

The average of 59.4 per cent for motor customers is strikingly near to the average demand factor of the small and medium size lighting customers.

In the paper by Mr. Lloyd before referred to, figures on 30,729 residence consumers in Chicago show the following percentages demand factors:

Residences 0.3 kw connected load	90
Residences 0.5 kw connected load	64
Residences 1 kw connected load	48
Residences 2 kw connected load	46

DIVERSITY FACTORS.

In order to make a complete study of diversity factors, it is necessary to know: first, the consumer's connected load; second, the maximum demand of the consumer at his service or meter; third, the maximum demand which he places on the transformer or direct-current feeder supplying him at the time of the maximum demand on that transformer; fourth, the maximum demand which he causes on the feeder supplying him at the time of maximum demand on the feeder; fifth, if the system is a large one employing sub-stations, the maximum demand placed by the consumer on the sub-station at the time of the sub-station peak load; sixth, maximum demand of the consumer at the time of the generating-station peak load. The reason for studying the maximum demand at the time of the peak load at the various points named is obviously to determine the investment which must be made in the various kinds

of apparatus to serve a given consumer. For example, it is the simultaneous demands of a number of consumers which determine the size of transformer necessary to serve that group of consumers.

The most complete study of diversity factor which has been made public is contained in a paper by Mr. H. B. Gear, of the Commonwealth Edison Company of Chicago, presented before the Western Society of Engineers and the Chicago Section A. I. E. E., March 23, 1910. Mr. Gear carried his analysis as far back as the substation busbars. By combining the diversity factors given by Mr. Gear in this paper with the demand factors of residence consumers given by Mr. Lloyd in the paper already referred to, some instructive figures are obtainable, as follows:

A connected load in Chicago consisting of 100 kw in residence consumers, each of 0.3 kw connected load, will cause a maximum demand at consumer's meters of 90 kw, a maximum demand at the transformers of 30 kw; a maximum demand at the feeder panel of 16.6 kw, and a maximum demand at the time of the substation peak of 14.5 kw.

For 100 kw connected residence load, consisting of 0.5 kw consumers, demands at meters would total 64 kw; transformers 21 kw; feeders 11.6 kw, and substations 10 kw.

For a connected residence load consisting of 100 kw in consumers having 1 kw connected, each, a total connected load of 100 kw would cause demands as follows: Meters, 48 kw; transformers, 16 kw; feeders, 8.9 kw; substations, 7.7 kw.

For a group of residence consumers, each of 2-kw connected capacity, the demand would be as follows: At meters, 46 kw; transformers, 15 kw; feeders, 8.3 kw; substation capacity, 7.2 kw.

For motor load, Mr. Lloyd's paper before referred to states that the ratio of average to connected load for the entire number of motor customers was 53.5 per cent. With this figure as a basis, and using the diversity factors for scattered motor load given by Mr. Gear, a connected load of 100 kw in motors in Chicago would make the following demands: At meters, 53.5 kw; transformers, 48.5 kw; feeders, 24.2 kw; substation capacity, 21 kw.

Taking the demand figures already quoted of 66.3 per cent for retail stores in Chicago, and assuming that these figures can be safely applied in connection with the diversity figures given by Mr. Gear for commercial lighting, the following demand for a connected load of 100 kw would obtain: Demand at meter, 66.3 kw; at transformer, 39.4 kw; at feeder panel, 33.2 kw; at substation peak, 28.8 kw.

In all of the figures so far given on Chicago conditions it will be noted that the analysis is carried back only as far as the substation. The relations between the different kinds of load and the peak load on the main generating station have not been shown. This diversity between different kinds of business is very important in its influence on the generating capacity required. The following figures were obtained from some typical local curves of the Chicago system.

A typical three-phase motor circuit daily load curve in December showed that 58 per cent of the maximum load on that feeder occurred at 5 p. m., which time is approximately the time of the peak on the whole system. If this curve is a fair average, therefore, the maximum meter demand of such a motor feeder should be multiplied by 58 per cent to get the demand caused on the system at the time of the system peak load. This would give by deduction from previous motor circuit figures a station peak of 12.2 kw for each 100 kw connected motor load.

A typical residence circuit daily load curve for December, published at the same time, showed that 75 per cent of the maximum load was on at 5 p. m. The maximum load on that feeder occurred just before 8 p. m. Applying this figure of 75 per cent to the figures already quoted on Chicago residence load diversity factor, there would be a maximum demand on the station for each 100 kw connected for various classes of residence load as follows: Small residences, 0.3 kw each, 10 kw station demand for each 100 kw connected; residences of 0.5 class, 7.5 kw station demand; residence of 1 kw class, 5.8 kw station demand; residences of 2 kw class, 5.4 kw station demand.

The commercial lighting load in Chicago at the time of maximum demand is so different in different districts of the city that no general conclusions can be drawn.

At Detroit, Mich., according to figures published at various times regarding residence lighting conditions there, it appears that for a connected load of 100 kw, consisting of a large number of residence consumers per block, the maximum demand on the transformers would be 20 kw; that on the substation supplying that district 14.3 kw; and that on the power station at the time of the system peak 7.1 kw. From the last two figures it is apparent that at the time of the peak load on the system, only 50 per cent of the residence lighting load is on. The remaining 50 per cent comes on later, subsequent to the peak on the system.

At Madison, Wis., the load curves published in connection with the commission's decision already referred to indicate that for a connected motor load of 100 kw, direct current, the maximum demand is 26 kw, of which 16 kw occurs at the time of the station maximum peak. For alternating-current residence lighting in Madison a connected load of 100 kw is estimated to cause 50-kw maximum demand at the meters, and from 15 kw to 20 kw at the transformers. Alternating-current commercial lighting at Madison for each 100 kw connected will cause 50 kw to 55 kw maximum demand at the transformers. Taking alternating-current, commercial and residence lighting together in Madison, 100 kw connected causes about 30 kw maximum demand at time of station peak.

At Spokane, Wash., analysis of the load on a residence feeder shows that for 100 kw connected load, the maximum demand on that residence feeder would be 37 kw.

At Paxton, Ill., 100 kw connected load in direct-current motors causes a maximum demand on that power circuit of 26 kw, and a maximum demand at the time of the station peak in December of 6.5 kw.

In small towns the business of a central station can be mainly classified under three general headings. Motor service, residence service and business district lighting service. Conditions vary widely as to how much these three services overlap at the time of the station peak in December. In some towns it is probable that the motor load is almost entirely off at the time of the main peak load on the system. On the other hand, residence lighting is very likely to overlap the main peak, because of the custom of keeping stores open certain nights each week in the smaller towns. So few small companies have residence and business lighting feeders separated that information on this matter is scarce. Load curves from one residence and one commercial lighting feeder of the Wabash (Ind.) Water & Light Company for Jan. 3 showed the same value of combined residence and commercial peaks at 5 p. m. and 6 p. m., but the elements making up the peak were different. At 5 p. m. the residence load was 35 per cent of the combined residence and commercial load, while at 6 p. m. the residence load was 44 per cent.

The figures which have been given on maximum demand on the power station caused by a given amount of connected residence load show why it is that some central stations have added a large number of residence consumers without increasing the peak load demand much.

In the application of these diversity and demand factors to the fixing of rates it is, of course, necessary to know approximately the investment which the central station must make in different parts of its system under existing local conditions. In order to show the method of working out the investment required for a given class of consumers per kw of connected load, assume a hypothetical case of a residence consumer whose connected load is 0.5 kw.

Taking this consumer's connected load as 100 per cent, assume that the following demand and diversity factors have been found to apply to the local conditions under consideration: Connected load, 100 per cent; maximum demand at

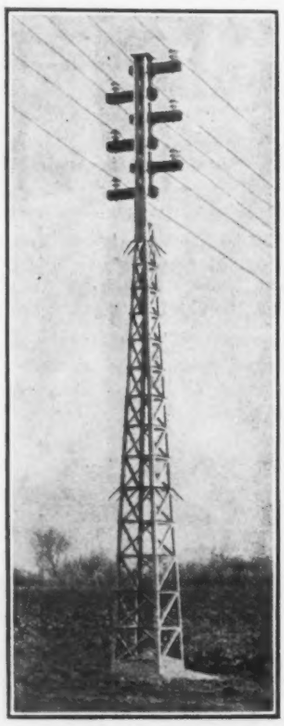
meter, 60 per cent of connected load; maximum demand at transformer, 25 per cent of connected load; maximum demand on feeder, 12 per cent of connected load; maximum demand on generating station at time of station peak, 10 per cent of connected load.

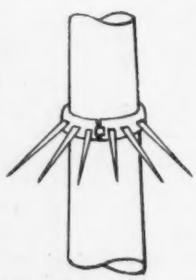
As to investments, assume meters at $12 each; transformer at $10 per kw of capacity; overhead lines at $50 per kw of maximum feeder demand, and power station at $100 per kw of maximum demand. For each 0.5 kw consumer there would then be the following investment: One meter at $12; transformer capacity, $10 × 25 per cent × 0.5 kw, or $1.25; lines, $50 × 12 per cent × 0.5 kw, $3; station capacity, $100 × 10 per cent × 0.5 kw, $5; investment for each 0.5 kw consumer, $21.25; investment per kw conncted of such consumers, $42.50. The foregoing figures begin at the consumer end and go back to the station. It is possible to calculate the investment beginning at the station end, but it is usually most convenient to figure from the consumer's end.

Wiring and Illumination

PREVENTING UNAUTHORIZED CLIMBING OF POLES.

Electric light and transmission companies are often subjected to criticism and lawsuits owing to deaths or injuries of persons who climb poles and come in contact with "live" wires, notwithstanding that the persons so doing were trespassing on the company's property. Such occurrences became so numerous in Switzerland, with its large number of electric transmission plants, that the matter was taken up for serious consideration. A commission of the Swiss Association of Electrical Engineers, comprising three directors of electricity works, decided last November to recommend to all members of the association that





Figs. 1 and 2—Applications of Porcupine Rings.

latticed poles be encased at least 6 ft. from the ground and that porcupine rings be attached to poles and towers in order to protect the lines from mechanical damage and the companies against accident claims. The illustrations herewith show the porcupine ring and its applications, the ring being only detachable by means of suitable socket keys. In addition, a warning shield 6.5 in. by 9.5 in. and reading "Danger to Life when touching the lines" is attached to the poles in a conspicuous place and in a substantial manner. Thus far the scheme has been fraught with good results.

LIGHTING OF SCHOOLS.

The formation of the Illuminating Engineering Society in the United States has been influential in stimulating an interest in school lighting in America. The eyesight returns of a number of authorities have proved that a deterioration in eyesight during school life exists, and it has been felt that this was at least partially attributable to unsatisfactory conditions of lighting.

But the conditions of eyesight in Europe have also given occasion for concern. In Germany, where some of the earliest enquiries were undertaken, the need for good lighting has for some time been realized and rules for the illumination of schoolrooms were long ago laid down by Professor Weber, of Kiel, and other observers.

In Great Britain the subject is also attracting an increased amount of attention, the more so because it is only last year that a regulation came into force according to which the London County Council undertook an official examination of the health of all children under their charge. Naturally it is being contended that an examination of this kind should include an investigation into the conditions of illumination, and the most recent reports of the London County Council Medical Inspector have contained special references to the subject. It is probable that the whole subject of school lighting will be the subject of discussion before the Illuminating Engineering Society in London shortly.

The first point is the importance of the hygienic side of lighting. During the last few years the medical profession has become firmly impressed by the importance of the influence of surroundings during school life on the health of the child and on its future career. During the years they are at school, it is pointed out, children are at a critical stage in their development and are specially sensitive to the prejudicial influences, bad illumination among the number. The importance of this question will be realized when it is stated that in the schools of London alone there are said to be over 1,000,000 children, and last year, for the first time, the medical inspection of the children became part of the official duty of the London County Council.

It may safely be said that among the other matters attended to by medical officers of health the conditions of illumination cannot be ignored. Although there is yet much to learn regarding the effect of light on vision the importance of good illumination, and the prejudicial effect of bad lighting, on the eyesight of children scarcely requires emphasis. Insufficient light accentuates the difficulties of fine work and imposes a strain even on the adult. It is specially prejudicial in the case of children. In this connection a recent annual report of Dr. J. Kerr, medical officer to the London County Council, said:

"A normal person of middle age will distinguish characters on paper in a poor light with greater readiness than a child, because the characters are more familiar to the adult and so much more readily recognized. Conversely a child requires a better light to read by than does an adult to whom reading is second nature. From a large number of experiments, the least illumination permissible on the school desk of a child has been found to be equal to 10 candle-meters (i.e., roughly one ft.-candle)."

Dr. Kerr had then examined a number of schools and reported on the lighting conditions. Only about 70 per cent of those visited could be classed as "good" and it must also be remembered that the higher standard of lighting imposed by the knowledge of good illumination which is now being acquired would, if strictly applied, probably still further reduce this figure. Until a more complete survey of the conditions of illumination in the large number of schools in London is made one cannot be certain as to how far the present conditions re-

quire modification. But it would be surprising if there were no respects in which the present conditions could be improved and the closer attention which the medical profession are now paying to the matter is likely to help to raise the standard.

Meantime there is one point on which fairly exhaustive enquiries in different countries have been made, namely, the eyesight conditions prevalent among school children; unfortunately there seems to be general agreement that the eyesight of schoolchildren tends to become steadily worse during school life. In the United States and in Germany very special efforts have been put forward to try and check these defects. One method which has been adopted in some districts in both countries has been the appointment of a controlling board in which the architect, the medical officer and the lighting engineer co-operate, in order to assure that the conditions should be as satisfactory as possible, and to supervise the plans of all new schools erected.

Now there is at least a probability that this deterioration in eyesight is partially due to bad lighting conditions. There is much to learn as to the way in which the lighting of schoolrooms should be arranged, but at least some errors are known which must at any cost be avoided.

First of all there is the necessity of providing sufficient light on each desk. As so much of the work in these schools is done during the daytime it is very important that the windows should be well placed and that the interior should have walls of a pale tint so that the light can be well distributed. In addition it must be recalled that daylight illumination varies enormously from day to day. Provision should, therefore, be made to secure enough light for the desks most remote from the window even on unusually dull days. Until one actually takes measurements one hardly realizes how much the daylight illumination varies in different parts of the room. In an office with which the writer is acquainted the illumination near the window often exceeds 100 foot-candles. Only a few feet further back it is, under the same conditions, frequently as low as 1 foot-candle. And in parts of the room more remote from the window the illumination is too low to read in comfort. Yet a casual observer would suppose from the appearance of the room that the light in all these parts was not very widely different in intensity.

Naturally the use of walls and ceiling of a light tint helps materially to reduce the disparity in illumination at different parts of the room. Some authorities have also laid stress on the value of light sun blinds in very bright weather for the purpose of diffusing the light. It is possible, with a clear sky, that one might actually *increase* the amount of light in a room by this means. Special window glass is also used for the same purpose, but this must be used with discretion. In some cases there is a tendency for the light to be thrown in horizontally in a somewhat powerful beam which gives rise to a sensation of glare. Dr. James Kerr, in some remarks at a meeting of the Illuminating Engineering Society in London recently, mentioned that he had encountered eyesight troubles due to this cause.

Another point of consequence is the direction from which the light comes. In writing, it is recognized, the light should come from the left so that no shadow is cast by the hand, and the rough rule that light should come from over the left shoulder seems to be a good one when it can be followed. In arranging the desks in a room, therefore, it seems desirable that the windows should be on the left. Many years ago Mr. Brudenell Carter showed how the contorted positions adopted by children when trying to write by badly placed lights were apt to give rise to spinal trouble.

Bright sources of light should, above all, be placed in positions such that they cannot strike direct into the eyes of the children. But when lamps are hung high up precautions must be taken to avoid the shadow of the head upon the book. A plan adopted in the schools of Munich was to arrange the windows on the left of the desks and also to place the artificial lights high up on the left so as to imitate the natural daylight conditions.

At recent meetings of the Illuminating Engineering Society there has been much discussion regarding the desirability of recommending that no lights should be used in interiors without their brilliancy being reduced to the hygienic permissible value by effective shading. Now if there is one case more than another in which a recommendation to this effect would be justified it is school lighting. One may well suggest that, whenever this can be done, the brightness of shaded lights should at least be cut down to below 5 candles per square inch. The usual recommendation that all bright lights should be excluded from the field of view is certainly good as far as it goes. But, strictly speaking, what does the "field of view" include? It is hardly possible to place a light so that it can never be seen in an interior, though one can certainly arrange that it should be *rarely* visible, especially when, as in a school, all the scholars should be looking in one direction. But, in view of the wearisome effect of occasional glimpses of bright naked lights we are surely justified in advocating shading and a minimum brilliancy, even though some loss of light be entailed thereby.

In this connection mention should perhaps be made of the inverted systems of lighting. The arrival of the powerful metallic-filament glowlamps has led to a revival of interest in this system and it certainly has one great advantage, the avoidance of "glare." But yet, apart from the question of efficiency, it must also seem now to be also recognized that there is something lacking in a room illuminated by this method. The monotonous uniform brightness it occasions is said to be wearisome to the eye, which requires rest by occasionally transferring itself to some surface less brightly illuminated than that upon which it has been gazing. Inverted systems have been effectively employed for school lighting in Munich and elsewhere, and are said to have answered very well. Possibly in some interiors the psychological effect of "flatness" may be less marked than in others. But probably it is best used only in conjunction with a certain amount of direct lighting.

It must also be recognized that in most classrooms and lecture theaters the illumination of the children's desks, of the blackboards and diagrams, and of the teacher's table, all require special attention. To flood the whole room with light, even if by so doing we succeed in avoiding excessive glare and provide as high an illumination as the circumstances seem to demand, does not seem to be the most ideal method of dealing with the problem.

And, lastly, a word or two may be said on the subject of measurement. With the higher standard of illumination which regular supervision of schools is likely to bring about, we may be sure that full advantage will be taken of modern methods of measurement. During the past few years we have seen the development of the illumination photometer, an instrument for measuring not the candle-power of the lamps installed, but *the actual illumination* furnished by them at any particular point. We may be sure that in the future the design of the illumination in interiors will not be based on any rough rule-of-thumb method specifying so many watts per square foot of floor area, etc. Such methods have their value, but merely as a preliminary guide. Intelligently utilized they may help to give an idea of the light or energy needed, but they say nothing as to *the distribution* of the light, nor do they take account of the local conditions. It seems probable that the lighting specifications of the future will take the form of definite directions for the provision of a certain minimum illumination on the desks, tables, blackboards, etc., and the conditions will be checked by the aid of illumination photometers.

Another tendency is for instruments of this class to be constructed on simpler and more portable lines. Several of the newest forms of instruments exhibited at recent meetings of the British Illuminating Engineering Society served to suggest that the design of the next few years will be in this direction of greater practical convenience rather than extreme accuracy. In time the measurement of illumination will doubtless come to be recognized as a perfectly simple and feasible process and instruments will be devised capable of being used by all interested in illumination.

ORNAMENTAL STREET LIGHTING.

At the second annual convention of the Indiana Electric Light Association, at Indianapolis, Aug. 18, Mr. E. Darrow, general superintendent of the Merchants' Heat & Light Company, of that city, read a paper on ornamental street lighting, in which he considered not only the tungsten fixtures which have recently become so popular throughout the country for curb-line illumination, but also the use of the new highly efficient arc lamps, as well as other illuminants which are of great promise, but of which at present little is known. Mr. Darrow's company inaugurated the installation of the extensive system of curb-line tungsten-fixture lighting on the business streets of Indianapolis, of which a description appeared in the issue of May 5, 1910. This is one of the largest examples of ornamental lighting in the country and has attracted much favorable comment. Before embarking on the construction of this installation, Mr. Darrow made a careful study of ornamental street-lighting systems. An abstract of his remarks on the general subject follows:

Throughout the country generally, there is fast arising a sentiment toward securing a better illumination of streets and public places, and in many cities downtown-lighting associations have been formed by the merchants, who are carrying to successful completion more effective and artistic street illumination. It has been realized by the merchants and property owners that new lighting systems were badly needed, particularly in business districts, and the outcome has been signally successful in several instances.

Kinds of Ornamental Street Lighting.—The following list shows the better-known illuminants which are available for exterior service:

1. Carbon-filament lamps in clusters or arches.
2. Graphitized-filament lamps in clusters or arches.
3. Tantalum-filament lamps in clusters or arches.
4. Tungsten-filament lamps in clusters or arches.
5. Nernst lamps, one to six glowers.
6. Enclosed arcs, direct and alternating current.
7. Magnetite arcs.
8. Flaming arc—regenerative arcs.
9. Carbide arcs.
10. Quartz-tube mercury-vapor lamps.

The efficiency, quality, color and other characteristics vary widely, the watts per candle-power ranging from 3½ for the carbon-filament down to 0.25 for the quartz tube.

Many smaller municipalities have shown a marked preference in business districts for arches with incandescent lamps, and spaced from 100 ft. to 200 ft. apart. A good illustration of this construction is at Norfolk, Va.

After a careful investigation and many suggestions as to the design of the construction flat steel arches, with a span of 40 ft., a width of 12 ft. and a rise of 48 in. were placed across the street and attached to the iron street-railway poles every 100 ft. Ten series incandescent center-span suspension outfits were attached to each arch. The lamps and reflectors alone hang below the arch, and the whole presents a very attractive appearance in daytime. Each arch is lamped with 60-watt, 6.6-amp street series lamps with automatic cut-outs and radial-wave reflectors. The neat yet substantial design and the graceful and symmetrical curve of the arch have been a source of much favorable comment.

Cities of first grade in the past have depended largely on series arcs for their street illumination. The characteristics of series-arc systems, both direct current and alternating current, need no special comment here. The practice has been to space these lamps in single units from 300 ft. to 600 ft. apart. Four-amp arcs of this type have been used in Cincinnati for the past eight years, the city's contract calling for lamps which consume 300 watts at the lamp terminal. These lamps are spaced in the down-town district about every 300 ft.

The illumination from these 4-amp arcs has been unsuccessful and has given Cincinnati the name of one of the poorest lighted cities in the country, so that it may be said that the 4-amp, 300-watt arc is an absolute failure as an illuminant for public places or thoroughfares. The failure in Cincinnati was also accentuated by the fact that the lamps were hung too close to the ground, viz.: about 12 ft., and by the mechanical imperfections of the lamp, which caused excessive outage.

The enclosed-arc lamp is essentially an American development and the long-burning feature, in spite of decreased efficiency, has made it a popular form of street lamp. Series-enclosed lamps consuming approximately 500 watts and using 6 amp to 7½ amp have been found quite satisfactory and reliable, when properly spaced and hung at proper height.

Metallic-flame arcs, employing some mineral element in the carbon electrodes to increase their luminous efficiency, are enjoying an increasing use in this country on account of their high efficiency and excellent light-giving qualities. They have the disadvantage of requiring more frequent attention and trimming, and to correct this difficulty practically the same series of remedies have been applied as in the infancy of the old open-arc lamp.

A comparatively new type of lamp, first brought out in Europe, but also now made in this country, is the regenerative-arc lamp. In this lamp the vapors from the impregnated electrodes are carried down, and reintroduced into the arc chamber, increasing the luminous efficiency of the flame. Such lamps may be operated for 75 hours without retrimming.

Fig. 1—Special Tungsten Street Lighting, Massachusetts Ave., Indianapolis.

Metallic-flame lamps of the magazine type, using one or more metallic electrodes, have been deservedly successful on account of their long hours of operation, low cost of maintenance, excellent efficiency, and good distribution. Late improvements in this type of lamp give promise of a steadier quality of arc and increasing burning periods of at least 200 hours. During the past year Toledo, Ohio, has installed a large number of these

arcs at street intersections, and in the downtown district on the main thoroughfares has erected two-lamp standards every 100 ft. or so. Although a flood of white light is procured, in the writer's opinion it is overdone, not artistic in any sense, and exceedingly unpleasant to the eye.

St. Louis, Mo., has now installed through the efforts of its Downtown Lighting Association a system of street illumination, using magnetite arcs. On Broadway a three-lamp standard has

Fig. 2—Tungsten Standards on Monument Place, Indianapolis.

been adopted. On all other business streets one-lamp standards are used. The Broadway system has been grossly overdone and gives an unpleasant glare. The three-lamp standards are spaced approximately 60 ft. apart, or 10 standards (each of three lamps) on every block, making a total of 30 arc lamps to the block.

The effect is brilliant, but as a permanent installation is in extremely bad taste. The other business streets are illuminated by four magnetite arcs at each street intersection and one intermediate lamp on each side midway. This latter arrangement gives six lamps per city block.

The most artistic and effective illumination is the plan adopted by Indianapolis, Des Moines, Seattle, Los Angeles, and other places. In Indianapolis each block of the main thoroughfares has six standards 84 ft. apart, each standard having five individual 100-watt tungsten lamps, each enclosed in a light ground-glass of thin opalescent outer globe. Washington Street is an extremely wide thoroughfare, yet with this system a newspaper can be read at any point with ease. The illumination is very even and well distributed, and the effect is exceedingly pleasing to the eye. Similar effects have been attained in the other cities mentioned above.

The carbide arc and the quartz tube are too little known yet to have a definite place assigned to them. The titanium-carbide electrode is most promising as a means of securing a high efficiency. Titanium carbide forms the cathode and is placed below an anode of copper, the latter being inactive, and not wasting away appreciably. The light is almost pure white with a slight tinge of yellow. It belongs to the flame type and its efficiency increases with current density and with increasing length of arc. On test, a lamp of this character at 3 amp and 103 volts and with a 1-in. arc consumes only 0.228 watt horizontal candle-power. The mean spherical candle-power was 535 and the mean hemispherical candle-power 738. The efficiency shows that the titanium-carbide arcs are most satisfactorily operated on constant-current circuits, hence this lamp should be particularly adaptable to existing street-series circuits.

The European quartz-tube lamp is heralded as giving a flood of beautiful golden-white light, faintly tinged with green, and so brilliant that one can read ordinary print 300 ft. from this lamp. This little lamp has a quartz tube about 4 in. in length and develops an illumination of 4000 mean spherical candle-power. The claims of this newcomer are an efficiency of 0.25 watt per candle-power, no renewals of electrode, no cleansing of globes, and no delicate parts to get out of order. This is almost an ideal specification, but in its present form the lamp is not adaptable for interior illumination. It has a powerful actinic action and in its development of ultraviolet rays is liable to produce burns on the flesh. As an exterior illuminant, it seem to be ideal, as any harmful qualities disappear when hung 15 ft. or 20 ft. from the ground. The lamp as now manufactured is for direct current only, but could easily be adapted to mercury-arc rectifier circuits.

In general, it may be said that the tendency in arc lamps is away from enclosed ones of relatively small candle-power and low efficiency toward arc lamps of higher candle-power, such as magnetite, carbide, etc.

Arrangement of Lamps.—With the increasing use of powerful arcs there has come a needless distress to the man in the street. When used for street illumination such arcs should be swung high. The time has passed when high-candle-powered arcs should be thrust in the faces of pedestrians. Such glare as is evidenced on Broadway, St. Louis, or Summit Street, Toledo, is a garish display, most unpleasant to the public, and should be regulated. The glaring arc can be and ought to be abolished.

The suspension of arc lamps of the higher candle-power should not be less than 20 ft. from curb to bottom of lamp, and is preferably 20 ft. to 25 ft. for best effects. When there are no trees the position of the lamp relative to the curb is not so important, but in suburban districts which are wooded the only satisfactory position is the middle of the street. In downtown districts it is almost universal practice now to have the standards and lamps on curb lines.

Frosted globes and diffusing reflectors tend to prevent troublesome reflections and mitigate glare. Spacing of units necessarily varies with the money available in each instance and the effect that is desired. Business districts vary to extremes. St. Louis, with 30 metallic-flame arcs per city block, has probably the maximum illumination, while many cities think they have sufficient light with one 500-watt arc each 400 ft. A fairly well lighted section should have not less than two arcs at each street intersection and two midway in the block. The spacing of the post type of units varies from 60 ft. to 100 ft. or from four to eight standards on each side of the street to a block.

Cost of Operation.—In consideration of costs, renewals, upkeep, etc., it is useless to attempt comparison on the basis of charges for lamps of a rated candle-power. Open arcs, direct-current arcs, enclosed arcs, magnetite arcs, etc., valued as street illuminants may vary over 150 per cent. Watts per square foot mean nothing if one does not consider quality. Again it is hard to compare cost of glare with illumination.

Following are some of the prices which municipalities and merchants' associations are paying for street service per year:

Cincinnati, 4-amp, 300-watt enclosed arcs, $60.00	$72.00
Toledo, 300-watt, magnetite	48.00
Boston, 500-watt, magnetite	118.00
St. Louis, 500-watt, Magnetite	80.00
Indianapolis, 500-watt a.-c. enclosed	62.50
Indianapolis, 500-watt tungsten standards, per front ft	1.05
Des Moines, tungsten standards, per front ft	1.58

The National Electric Light Association has recommended the selling of illumination, rather than energy, but, unfortunately, no principles have been evolved whereby the effective lighting on two streets can be compared on a basis of illumination. A service contract for a particular and specified illuminant which has been previously tried out is the only safe way to handle street-lighting contracts at present.

It will be noted that the Norfolk, Va., decorative-arch lighting for each 400-ft. block required 3000 watts at lamp terminals. In Cincinnati there are four 300-watt enclosed arcs to the block or 1200 watts at lamp terminals. In St. Louis the Broadway special illumination shows 30 300-watt metallic-flame lamps, or a total of 9000 watts per block. In Indianapolis the standards are 12 to a block, each standard containing five 100-watt tungsten lamps and representing 6000 watts. Thus it will be seen how widely typical installations vary as to quantity and quality.

With arc lamps, under the usual conditions attendant on aerial-line construction, with average spacing of lamps, the cost per lamp erected, exclusive of station equipment, varies from $60 to $100. In underground districts the construction costs may reach as high as $250 per lamp. The cost of installing the 667 magnetite lamps in St. Louis was close to $140,000. The depreciation in this equipment is easily 10 per cent per annum.

Maintenance costs in the curb-line system of illumination, such as adopted in Des Moines, Seattle and Indianapolis, are about as follows per 1000 hours' burning, for each post carrying five 100-watt tungstens:

I. Maintenance of Tungsten Standards:

Five lamps	$5.00
Glassware	2.00
Cleaning and attendance	1.00
Operation	2.00
500 kw-hours	5.00
	$15.00

II. Maintenance of Direct-Current Enclosed Arcs:

Carbons and trimming	$1.20
Repairs and globes	.50
Depreciation	2.00
500 kw-hours	5.00
	$8.70

III. Maintenance of Metallic-Flame Arcs.

Trimming	$7.50
Repairs and glassware	2.00
Depreciation	2.00
500 kw-hours	5.00
	$16.50

IV. Maintenance of Flaming Arcs:

Carbons and trimming	$9.50
Repairs and globes	2.00
Depreciation	2.00
500 kw.-hours	5.00
	$18.50

The power required for these various systems of lighting varies from 6 kw to 60 kw per mile of roadway. An ordinary 60-ft. roadway has about 315,000 sq. ft. to the mile, and with the American average of 5 kw to 10 kw per mile, this allows a ridiculously low wattage per square foot. The power required per square foot per ft.-candle is about as follows:

Tungsten lighting	0.3 to 0.5 watt
Enclosed direct current arcs	0.25 to 0.45 watt
Metallic-flame arcs	0.06 to 0.13 watt

The radius of effective illumination of the tungsten standards used in Indianapolis is about 100 ft.; for enclosed-arc lamp, 125 ft., and for metallic-flame lamps, 300 ft.

From the above consideration it would appear that through the combined influence of public sentiment, first cost and maintenance charges, the series constant-current metallic-flame lighting units are driving all other types of illumination from the residence and suburban districts of our municipalities. However, there is a strong trend in the business sections of our more progressive cities to artistic lighting effects, as is evidenced by the many attractive forms of arches and curb-line lighting units which have been developed in the past 18 months.

A few years ago a lamp post was simply a thing to have a lamp on. To-day it is considered a factor of municipal enterprise and intelligence, and downtown merchants' lighting associations have done much to set a new standard for artistic and efficient public lighting.

[The accompanying illustrations show examples of the special tungsten street lighting installed in Indianapolis by the Indianapolis Light & Heat Company, and which, together with the generally similar installation of the Merchants' Heat & Light Company of Indianapolis, makes that city one of the best lighted ones in the country.—Ed.]

NEW TELEPHONE PATENTS.

INTERCOMMUNICATING SYSTEMS.

Mr. E. R. Corwin, of Chicago, has patented an intercommunicating apparatus and system, which he has assigned to the Corwin Telephone Manufacturing Company. This system contemplates a switching device at each station, interconnecting lines and signals and an exchange line accessible to all stations and answered from a particular station, which may extend the call as desired. The patent relates to details of arrangements.

Mr. A. K. Andriana, of San Francisco, has patented improvements in his step-by-step intercommunicating lock-out system. This system employs a sending and a stepping mechanism at each station. The system is a lock-out one and in the present instance, if a switching operation be begun by moving the sender, the dial is locked against backward motion until after the receiver is restored. Again, if a signal be sent, the dial at once becomes locked against further motion in either direction until the receiver is restored.

Another lock-out system, this, however, contemplating the use of a central switching station or exchange, has been patented by Mr. L. E. Hicks, of Stinson, W. Va. This provides the usual step-by-step features and a signal to indicate the busy or free condition of the line.

COMBINATION CIRCUIT.

In talking-picture shows where a phonograph does the talking, the phonograph behind the scenes and the picture machine in front must move synchronously. Mr. G. E. Hoglund, of Chicago, has arranged a combined synchronizing and telephone circuit from the stage to the operator, which he has patented and assigned to Mr. W. N. Selig.

AUTOMATIC SYSTEM.

A patent granted to A. H. Dyson, of Chicago, and assigned to the Kellogg Switchboard & Supply Company, describes improvements in that type of automatic system where a master switch is used. In these systems, the first action of an initiated call at the exchange, is through the agency of the master switch to pick up an idle selector. It will be understood that each master switch serves a considerable number of subscribers and thus if it fails to operate there are serious consequences due to the simultaneous disablement of the whole group of lines. To obviate this in the present invention special circuits are provided so that in the failure of the usual mechanism another is automatically substituted. A further feature is the locking up of the called subscriber's cut-off relay, so that if a call be abandoned by the calling party with the called station

receiver off the hook, there will be no effect at the called station master switch to tie up a selector permanently. In this system also the complete clearing out of a connection follows the hanging up of the originating or calling station.

LETTER TO THE EDITOR.

Transmission Line Calculations.

To the Editor of Electrical World:

SIR:—I wish to thank Professor Blondel for calling attention to his priority in the subject mentioned in his letter published in your issue of Aug. 25. The writer is aware that the power series for hyperbolic functions has been known to mathematicians for a considerable time, yet it seemed that the approximate methods were needlessly in vogue. This can hardly be due to other than a dislike of hyperbolic functions. The article mentioned compared the true infinite series with the finite series representing various approximations. If, by so doing, it had made the exact calculation preferable to the approximations, it would have fulfilled the writer's expectations. The writer regrets that he did not search the foreign papers with regard to the points mentioned above. The notation used was that of Dr. Steinmetz, and does not need the writer's defence.

Ithaca, N. Y. JOHN F. H. DOUGLAS.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Enclosed Machines.—P. AMSLER.—For many purposes completely enclosed electric machines are required. If use is made of machines of standard construction simply enclosed in an air-tight casing their permissible output is only from 35 to 40 per cent of that of the open machines. To improve the conditions it is advantageous to employ forced ventilation. A fan may be provided on the rotor axle within the machine, special air channels being employed. The fan sucks fresh air through one channel and ejects it through the other channel. The present author uses this principle, but employs the base plate as an air cooler. It may contain special water-cooling pipes or simply have a corrugated surface so as to provide a large radiation surface. The machine and the base plate are enclosed air-tight. A ventilator mounted on the rotor axle drives the inside air through the machine and through the base plate, where it is cooled by the water pipes. Results of tests are given; it is stated that with relatively small extra cost the enclosed machine can be arranged so as to have the same permissible output as the open machine.—*Elek. Zeit.*, Aug. 18.

Control of Induction Motors.—A note on a recent British patent (24,269, 1909; Aug. 11, 1910) of the Siemens Brothers Dynamo Works, Ltd. For the speed control of a large polyphase induction motor use is made of a frequency-transformer to supply a current of variable frequency to the rotor. This transformer consists of an induction motor coupled to a polyphase commutator machine with slip rings. The slip rings of the induction motor are connected to the three brushes of the commutator machine which supply the variable-frequency current and the speed of the set depends on the frequency of the currents generated.—Lond. *Elec. Eng'ing*, Aug. 18.

Care of Commutators.—L. M. JOCKEL.—The surface of the commutator must be kept clean and smooth if good commutation is to ensue. When the machine is under load the commutator can be kept clean by the occasional application of a pad or cloth soaked with benzine, and afterward finishing off with a clean dry cloth. The use of good-quality carbon brushes obviates the necessity of lubricating the commutator, but occasionally the brushes cause an excessive noise or "hissing" and this is usually remedied by the application of paraffine wax or a slight trace of mineral oil. Paraffine wax has the disadvantage that it accumulates on the brushes along with the copper and carbon dust, and is troublesome to remove, and it also causes the machine to drop its load slightly when it is applied. The use of a slight amount of mineral oil is very beneficial in promoting a good running skin or surface on the commutator, and this treatment is applied regularly to the machines in the British Royal Navy. With special brushes such as the "morganite," a hard, smooth skin can easily be obtained on the commutator. A common trouble is the formation of flats on the commutator. These may arise from many causes, but are often due to neglected slight sparking. A frequent cause of sparking is the unequal wear of the copper commutator bars and the mica insulation. The trouble can usually be overcome by turning or grinding out the bad mica, or in some cases by sawing out the mica until it is below the level of the segments. If a lathe or emery grinder is not available, recourse must be had to hand work, and a somewhat temporary job can be made by using a file moistened with paraffine or a light lubricant. Should the flat not be very deep, it may be ground out with emery cloth or glass-paper, using a wooden pad hollowed out to the curvature of the commutator and carefully bedded to it. The brushes can be quickly bedded down by increasing the pressure on the springs, and using emery cloth. The correct pressure on the brushes is usually from 1.5 lb. to 3.0 lb. per square inch of bearing area; the pressure can be ascertained by using a spring balance. After trueing up a commutator, and rebedding the brushes, a good working surface can generally be secured by frequently cleaning the commutator and treating it with slight applications of good mineral oil or vaseline.—Lond. *Elec. Eng'ing*, Aug. 11.

Commutator Segment Insulation.—A note on a recent British patent (23,225, 1909; Aug. 4, 1910) of the British Thomson-Houston Company (General Electric Company of this country). An insulating material which will wear down evenly with the segments is composed of 237 parts of dry kaolin, 37 parts powdered glass, 88 parts green silko, 2 parts red silko and 156 parts asbestos. The mixture is made into sheets, treated with silicate of soda, and finally fired at a high temperature under considerable pressure. The compound is stated to have high dielectric and mechanical strengths, and to withstand high temperatures.—Lond. *Elec. Eng'ing*, Aug. 11.

Prevention of Syphoning of Transformer Oil.—J. C. Dow.—Oil may be syphoned out of a transformer case by the leads in two ways—by the insulation, or by the capillary action of the oil in the spaces between the wires of the flexible leads. To prevent the former all that is necessary is to remove the insulation for an inch or two above the oil surface within the case. To prevent the second action the spaces between the wires must be filled with some oil repellant. This can be accomplished by using a solid lead or by filling the flexible lead with solder; neither method prevents the oil from creeping along the surface and both require the lead to be non-flexible, at least for part of its length. It is possible, however, to fill a short section of the cable above the oil in the case with glycerine, thus preventing the oil from syphoning and still leaving the cable flexible. The cable must first be stripped of its insulation for 2 in. or more, depending on its size, the oil thoroughly removed from that section of the cable and pure glycerine run in. The oil can be removed with gasoline and this must be done thoroughly all through that section of the cable. The slight residue left from the evaporation of the gasoline will prevent the glycerine from working into the cable, but this residue can be removed with alcohol. The removal must be thorough. The alcohol should be removed before drying by means of water; while the cable is still wet, the glycerine should be worked in.

The glycerine should be as pure as possible, but it may be necessary at first to use a solution of glycerine in water to make it enter the cable. Glycerine is an oil repellant, but is an absorber of moisture, and hence this method should be used with caution on high-voltage transformers.—*Elec. Jour.*, September.

Lamps and Lighting.

High-Candle-Power Tungsten Lamps for Indirect Illumination.—B. Monasch.—After having discussed in the first part of his paper indirect illumination, the author now deals with semi-indirect illumination in which the high-candle-power tungsten lamps are simply surrounded by an opal glass globe. The specific consumption of semi-indirect illumination is only a little less than that of completely indirect illumination, while the non-uniformity of illumination is greater. Direct illumination of interior rooms with high-candle-power tungsten lamps shows the same low specific consumption as direct illumination with open-arc lamps with pure carbon electrodes. Both arc lamps and tungsten lamps when used for indirect illumination are considerably more economical than the Moore vacuum tube lamp. The following summary is given of the specific consumption of different systems of lighting interior rooms:

INDIRECT ILLUMINATION.

	Specific Consumption
Open direct-current arc lamp with pure carbon electrodes in normal position	0.188 to 0.303
Open direct-current arc lamp with pure carbon electrodes in reversed position, the positive being above the negative	0.136 to 0.220
Open alternating-current arc lamp with pure carbon electrodes	0.339
Tungsten lamp with direct-current or alternating-current	0.259 to 0.318

SEMI-DIRECT ILLUMINATION.

Open direct-current arc lamp with pure carbon electrodes in normal position	0.15 to 0.35
Enclosed direct-current arc lamp with pure carbon electrodes	0.367
Tungsten lamp with direct-current or alternating-current	0.225 to 0.260

DIRECT ILLUMINATION.

Open direct-current arc lamp with pure carbon electrodes	0.15 to 0.3
Carbon incandescent lamp	0.5 to 1.2
Tungsten lamp with clear globe	0.15 to 0.175
Tungsten lamp with frosted globe	0.22 to 0.25
Moore vacuum-tube lamp with alternating-current	0.445

In every case the specific consumption is given in watts per lux per square meter.—*Elek. Zeit.*, Aug. 18.

Drawn Tungsten Filaments.—A note on a recent British patent (3,981, 1910; Aug. 11, 1910) of the British Thomson-Houston Company (General Electric Company of this country). In order to pass a tungsten rod or wire into the die for drawing it must be pointed at the end. The metal is exceedingly hard and hence, to effect this, the wire is dropped into a bath of a fused oxidizing salt such as potassium or sodium nitrate. The chemical action points the wire and leaves a clean surface free from pits.—Lond. *Elec. Eng'ing*, Aug. 18.

Supports for Metallic Filaments.—A note on a recent British patent of F. Salzer (6658, 1910; Aug. 4, 1910). In order to protect the metallic supports, or leading-in wires, from the effects of the high temperature of the filament, the former are coated electrolytically with a thin film of chromium. The coated wires are heated to anneal the coating and render it flexible.—Lond. *Elec. Eng'ing*, Aug. 11.

Moore Vacuum Tube Lamp.—W. Wedding.—An English translation of his recent German paper on tests of the Moore vacuum tube lamp.—Lond. *Electrician*, Aug. 19.

Generation, Transmission and Distribution.

Electric Power for Railways.—R. Darlington.—A lecture delivered before the Richmond Railway Club in which he compares the direct-current, the three-phase and single-phase systems for trunk railroads. Power plants will generally represent about 25 per cent of the total cost of electrification, and will usually cost about the same for the three systems. The maximum load upon the power plant might not vary greatly for the three systems, but the average load would be greatly in favor of the two alternating-current systems, compared with the direct-current system, on account of the very large losses on the direct-current system between the power house and the trains. The conductors and substation apparatus for the transmission and distribution of electric energy along the tracks is usually the largest item of cost for the electrification of ordinary steam railroads, and is several times as large for the direct-current as for the single-phase system, and is nearly twice as large for the three-phase as for the single-phase system. The operation and maintenance cost of the substations and transmission and distribution conductors are greatly in favor of both of the alternating-current systems as compared with the direct-current system. The cost of electric locomotives and electrical equipment on motor cars will generally be somewhere between 10 and 40 per cent of the total cost of electrification of steam railroads, and single-phase locomotives will cost somewhat more than direct-current and three-phase locomotives. Reliable alternating-current railroad apparatus being available, the author concludes that it is now often advisable to substitute electric power for steam for purely economical reasons.—*Elec. Jour.*, September.

Determination of Pulley and Belt Sizes.—C. B. Mills.—An article giving a chart which permits an easy graphic solution of belt problems. Some numerical examples are added. In the second part of the article the author discusses shaft stresses. It is shown that the limitations imposed by the bearings of a motor are the principal factors in determining the smallest pulleys which may be used, good practice allowing a smaller margin of safety in these parts than in others, owing to their ability to give evidence of distress by heating long before the danger line is reached.—*Elec. Jour.*, September.

Traction.

Interurban Tramway.—An illustrated description of the new motor cars of the interurban tramway from Heddernheim to Homburg, which is a continuation of the line from Frankfurt to Heddernheim. On the latter line and within the city of Homburg an e.m.f. of 550 volts is employed on the trolley wire, while on the line between Heddernheim and Homburg 1000 volts is employed to get higher speeds. The construction of the motor cars and the switches for regulation are described and illustrated.—*Elek. Zeit.*, Aug. 18.

Electric Propulsion of Ships.—A. Blair and J. F. Wilson.—A paper read before the Belfast Association of Engineers. The authors consider a cross-channel vessel, the steamship *Londonderry*, and give particulars of the suggested equipment for electrical propulsion. Suction gas plant is proposed for generating energy for the electrically-driven auxiliaries, while high-speed turbines would be employed for the main generators. Details of the equipment are given.—Lond. *Electrician*, Aug. 19.

Installations, Systems and Appliances.

Accidents in Mines in Great Britain.—The annual report for the year 1909 of R. A. S. Redmayne, chief inspector of mines, shows that the total number of fatal accidents in the coal mines of the United Kingdom last year was 1182, compared with 1138 in the year 1908. These accidents involved the loss of 1453 lives, as against 1308 in the previous year. Only 11 of the accidents, involving the death of 13 persons, are attributed to electrical causes. Electrical accidents are accountable only for about 1 per cent of the total number of fatalities, and in all cases they occurred underground. The number of deaths due to electricity in 1908 was 15, 4 of these being above ground. Last year's electrical fatalities, therefore, show a decrease of two compared with those of 1908. As regards non-fatal accidents, 153,306 persons were disabled for more than seven days, compared with 141,851 in the previous year. Of this large total, electrical causes account for 38 cases of injury to persons working underground, and in 18 cases to workmen above ground, the figures for last year being 22 and 12 respectively. The proportion of accidents attributable to electricity is therefore 0.4 per cent. In the case of metalliferous mines, no fatal accident and one instance of injury are stated to be due to electricity, the total number of accidents in this class being 40 killed and 1434 injured. The third heading under which

accidents are classified is "in and about quarries"; 84 deaths and 4856 cases of injury are recorded, electricity being in no instance responsible.—Lond. *Electrician*, Aug. 19.

Battery Boosters for Three-Wire Battery Installations.—A note on a recent British patent of A. M. Taylor (14,212, 1909; Aug. 11, 1910). Instead of having two separate booster armatures connected to the two sides of the system, a single booster of double the voltage is employed. This has slip-rings connected to two tappings on its armature winding, and these are connected to a choking coil or balancer to give the neutral point and to compensate automatically for fluctuations in the out-of-balance current. Further, where two boosters are arranged for series-parallel grouping, the neutral point is obtained by similar static balancers. The balancers also protect the boosters from undue rushes of current caused by external short-circuit.—Lond. *Elec. Eng'ing*, Aug. 18.

Wires, Wiring and Conduits.

Ageing of Fuses.—In reviewing the electric work at the Reichsanstalt in 1909 a series of experiments on the ageing of fuses is mentioned. It frequently happens in practice that fuses undergo a considerable increase in resistance after being in use over an extended period. The Reichsanstalt has made a number of experiments upon this phenomenon at the request of the German Association of Electrical Engineers. Three causes are advanced for the so-called "ageing": (1) Change of the fuse wires by overloading; (2) pulverization of the metal under high voltages; (3) influence of the filling material. Experiments were first made with silver wires stretched in the open, the wires being 0.5 mm, 0.25 mm and 0.1 mm (20 mils, 10 mils and 4 mils) thick. A light load was sometimes applied, the wires at other times being rendered slightly incandescent with the current. At the outset all wires showed an increase of a few parts of a per cent in resistance, this result being traceable to the fact that the wires, made hard by drawing, are softened by being heated by the current. The 0.5-mm and 0.25-mm (20-mils and 10-mils) wires showed no noteworthy change in resistance either when the load applied was trifling or when it was considerable; the same can be said of the 0.1-mm (4-mils) wire, loaded with a weak current. On the other hand, the 0.1-mm wire when loaded with 2 amp suffered a permanent increase (20 per cent) in resistance, eventually fusing after 12 weeks. The metal appeared to be not simply oxidized, but also to have undergone extensive structural changes. The behavior of the test wires was independent of the manner of soldering. At present experiments are being repeated on the 0.1-mm wire with lower currents. No results are yet available as to pulverization on high voltages, or as to the influence of the inner material of the fuses.—Lond. *Elec. Rev.*, Aug. 12.

Joints of Aluminum with Copper.—A note on a recent British patent (20,106, 1909; Aug. 11, 1910) of C. J. Beaver and E. A. Claremont. It covers a box for protecting and enclosing a mechanical joint between overhead cables of copper and aluminum respectively, to prevent electrolytic action. The mechanical connector is of copper or aluminum, and over the end engaging with the cable of unlike metal is fixed a metal shell. A bush of a non-metallic material is inserted between the neck of the shell and the cable, and the shell is filled with a bitumen or wax compound. All joints between dissimilar metals are thus protected from the atmosphere.—Lond. *Elec. Eng'ing*, Aug. 18.

Safety Device for Wiring.—An illustrated description of a safety device which is being introduced in England to enable repair work to be done on overhead lines at pressures up to 7500 volts. It consists of a thick rubber trough or mat. One is placed over each of the wires near which the man is working.—Lond. *Elec. Eng'ing*, Aug. 11.

Electrophysics and Magnetism.

Coherers.—W. H. ECCLES.—The conclusion of his Physical Society paper. The author puts forward the hypothesis that the properties of an oxide coherer may arise solely from the temperature variations caused in the minute mass of oxide at the contact by the electrical oscillations and by the applied e.m.f. He examines the hypothesis mathematically and shows that most of the phenomena recorded can in this way be accounted for as perfectly as the present state of the measurements permits.—Lond. *Electrician*, Aug. 19.

Parallel Connection of a Number of Circuits.—J. KUHN.—The author gives the general solution of the problem of finding the current in any one of n circuits connected in parallel, each circuit containing an ohmic resistance and a constant e.m.f. The author shows that the solution becomes very simple when use is made of the joint resistance or the joint conductance of all the different circuits. He then gives a general formula for determining the current in any circuit and also a simple graphical solution.—*Elek. und Masch.* (Vienna), Aug. 7.

Electric Resistivity of Alkaline Metals.—L. HACKSPILL.—An abstract of a French Academy paper on the results of measurements made with a double Kelvin bridge. The resistivity at 0 deg. C. in microhm-centimeters is 18.1 for cæsium, 11.6 for rubidium, 6.2 for potassium, and 4.3 for sodium.—*La Lumière Elec.*, Aug. 3.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—A note on a new plant just opened in France for the fixation of atmospheric nitrogen by means of electric arc discharges. It is located at Roche de Rame, Hautes-Alpes, and employs the Pauling process, in which electric discharges are used between electrodes of the same kind as used in the so-called horn type of lightning arrester. Water-power is utilized; the hydroelectric installation comprises four 2000-hp units. The furnaces are arranged in two rows in a separate building. Each furnace has two arcs in series. Three-phase currents at 4000 volts with a frequency of 50 periods are employed. The phases are divided equally between three furnaces. At present the rating of each furnace is 500 hp, but this will probably be raised to 1000 hp. In normal operation the yield of nitric acid is stated to be from 60 grams to 70 grams per kw-hour. The whole plant is almost automatic, so that little hand labor is required.—*Met. and Chem. Eng'ing*, September.

Units, Measurements and Instruments.

Use of Thermo-Junction for High-Frequency Current Measurements.—C. M. DOWSE.—One of the most sensitive methods of measuring small alternating currents of high frequency is that in which the heat developed in a short, fine wire raises the temperature of a thermo-junction soldered to it, and the resulting thermo-e.m.f. is detected by a galvanometer of suitable resistance connected to the junction. If the diameter and length of the wire are kept small, variations in the effective resistance with frequency are negligible. This principle, which has been employed before by others, is used by the author for the construction of a small inexpensive portable instrument of a wide range. He prefers to make the junction of copper and eureka, because these junctions are reliable, reproducible and fairly permanent. The most convenient arrangement is to use two junctions mounted closely together on a wooden or ebonite base. There are two possible methods of construction as shown in Fig. 1. In the construction of the left-hand diagram wires of two different materials are stretched between opposite terminals and soldered at the center. The circuit in which the current is to be measured is joined to *AA*, and a

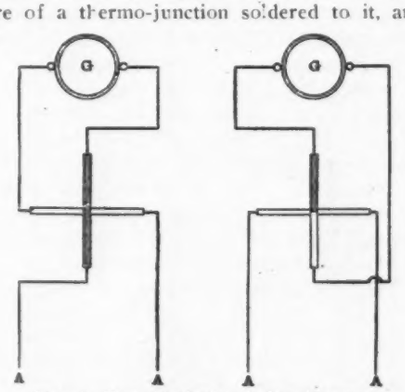


Fig. 1—Two Methods of Construction.

galvanometer G is connected to the remaining terminals, both circuits being composite. The author prefers the other arrangement shown in the right-hand diagram in which a heating wire carrying the current to be measured is stretched between opposite terminals, but the junction wires are in a separate circuit and the two ends are soldered to the center of the heating wire B. No part of the heating current now passes through the junction, but there is a possibility of an error in calibrating if the junction wires are not at the same point on the heating wire. This type is more difficult to construct than the crossed type, but it is much more satisfactory from every other point of view. Data are given on the best method of soldering. An accurate instrument of considerable range and flexibility can be constructed by combining a series of standardized junctions with the necessary plug switches and a suitable galvanometer. The arrangement is seen in Fig. 2 where A, B and C represent

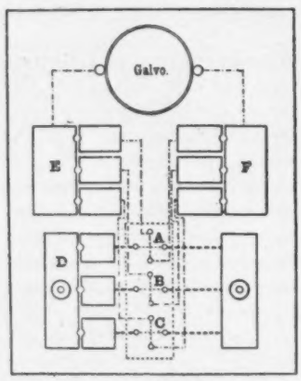


Fig. 2—Arrangement of Thermo-junction.

three junctions which can be placed separately in circuit by the plug switch D. The junction wires are joined to the galvanometer by the plug switches E and F. The circuit, including the heating wire, is as straight and short as possible and the connections should be made with stranded wire. Many useful applications can also be made of the differential action of two equally sensitive junctions, and the author has developed the method shown in Fig. 3 which enables low capacities to be

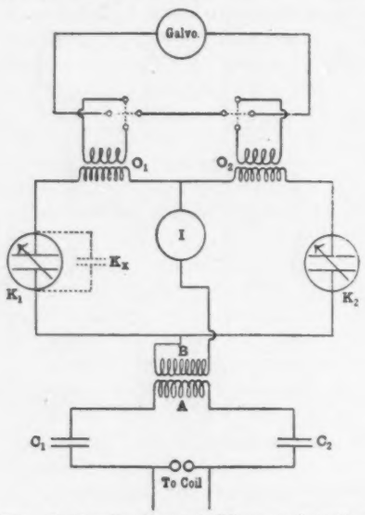


Fig. 3—Application of Thermo-junction.

balanced with ease and accuracy. A coil A which is in an oscillation circuit with capacities C_1, C_2 forms the primary of an oscillation transformer, the secondary B of which can be removed so as to vary the coupling. Connected to the terminals of B are an indicating instrument I and a pair of similar circuits each containing a condenser of variable capacity, K_1, K_2, and the primary coil of a small oscillation transformer, O_1, O_2. The secondary coils are in very close coupling and are joined to the terminals of the heating wires of two similar thermo-junctions. The junctions are in opposition and are connected to a sensitive galvanometer. The deflection is reduced to zero by balancing the variable capacities K_1, K_2, and the sensitiveness is adjusted by varying the coupling between A and B. The indicating ammeter I shows the value of the current in the main circuit, and experiment will easily show the maximum value that can be reached without burning out the junctions. After noting the readings of the variable capacities, the capacity K_x to be measured is joined in parallel with one of the variable-capacity condensers, and the capacity is varied until the deflection is again reduced to zero. The difference in the readings indicates the capacity of the condenser K_x.—Lond. *Electrician*, Aug. 19.

Electric Pyrometry.—An abstract of a paper by R. S. Whipple on recent progress in resistance pyrometry and thermoelectric pyrometry; also abstracts of papers by W. P. White on the thermo-element as a precision thermometer.—*Met. and Chem. Eng'ing*, September.

Stroboscopic Disk.—K. Laudien.—After describing some well-known applications of the stroboscopic disk, for instance for measuring the slip of an induction motor, the author describes its application for demonstrating directly to the eye the angle of phase difference. For this purpose the synchronously-revolving disk is illuminated by two alternating-current arc lamps A and B. While A is connected to the alternating-current circuit in series with a non-inductive resistor, the lamp B is connected to the same circuit in series with an inductance coil. The disk then shows two light crosses, one corresponding to lamp A and the other to lamp B, and the angle between the two crosses corresponds to the phase displacement between the currents of the two lamps. The demonstration can be improved by using electrodes giving lights of different colors in the two lamps.—*Elek. Zeit.*, Aug. 18.

Current Indicator for Electric Speed-Indicating Apparatus.—A note on a recent British patent of J. Rennie (16,621, 1909; Aug. 11, 1910). This instrument consists of a compound strip of brass and iron loosely coiled up and fixed at the outer end, the inner end having a pointer attached to it. When heated up by the current, the strip uncoils and moves the pointer. The scale is attached to a second strip, which, by moving the scale, compensates for atmospheric temperature variations. A contact placed on the scale causes a bell to ring when the pointer reaches it. For use with a speed indicator the current generated by a small generator is passed through the strip.—Lond. *Elec. Eng'ing*, Aug. 18, 1910.

Testing.—In a continuation of the serial by E. F. Collins on commercial electric testing the author deals with transformer tests. In a second article by C. D. Haskins on appliances for electrical measurements the author deals with portable instruments, recording instruments, and intergrating meters.—*Gen. Elec. Rev.*, September.

Telegraphy, Telephony and Signals.

Glasgow Telephone Exchange.—An illustrated description of the new central telephone exchange of Glasgow. It replaces an old flat-board exchange on the call-wire system, and is a 10,000 line central battery exchange with many new features. In the operator's cord circuit the repeating coil is dispensed with, condensers are included in the speaking circuit, and a 40-volt battery is used instead of a 24-volt.—Lond. *Elec. Eng'ing*, Aug. 18. A fully illustrated description of the same exchange was begun in Lond. *Electrician* Aug. 19.

Wireless Telephony.—P. Brenot.—The conclusion of his review of the present position of wireless telegraphy and telephony. In the present installment he deals with wireless telephony and sketches the success obtained by various experimenters. He concludes, however, that wireless telephony has not yet passed the experimental stage and that it cannot compete with wireless telegraphy. Some notes are added on wireless transmission of energy to actuate certain apparatus.—*La Lumière Elec.* Aug. 13.

Miscellaneous.

Combination of German Electrical Companies.—A note on a proposed combination of interests between the Lahmeyer Elec-

tric Company of Frankfurt and the Bank for Electric Developments in Zurich. The significance of the combination is due to the fact that the latter bank is practically controlled by the Allgem. Elek. Ges. of Berlin. It is further asserted that there has been for some time past a friendly understanding between the Allgem. Elek. Ges. and the Siemens-Schuckert group, so that a general concentration of interests is predicted with a view to eliminate wasteful competition. The competition of recent years is said to have been increased considerably by the rapid growth of the Bergmann Elektricitäts Gesellschaft of Berlin.—Lond. *Elec. Eng'ing,* Aug. 11.

Electric Heating.—GOISOT.—A long paper presented before the Marseilles Congress on the different systems of electric heating. In discussing the application of the Joule effect, the author deals with non-metallic resistors (carbon, silicon) metallic resistors, and metallic powders mixed with non-conducting particles. Heating of the arc and heating by the induction principle are next discussed, together with various applications of electric heating in the house and kitchen, in the laboratory, and in different industries.—*La Houille Blanche,* August.

Electric Heater.—A note on a recent British patent of F. W. Forbes (16,547, 1909; Aug. 4, 1910). Nickel or other resistance wire is wound on a grooved core of porcelain, and enclosed in a closely fitting quartz tube. Before fitting on the tube the grooves are filled up with plaster of Paris or a phosphate or silicate cement. The space between the core and the outer tube is thus filled up with paste, and this facilitates the transfer of heat from the wire to the liquid. The wire is heated before the paste sets, so that it makes a channel large enough for itself to expand in.—Lond. *Elec. Eng'ing,* Aug. 11.

Standardization Rules.—A set of rules adopted by the Union des Syndicats de l'Electricité on the rating of electrical machinery, permissible rise of temperature, overload capacity, self-regulation, efficiency, insulation tests, power-factor and frequencies.—*La Houille Blanche,* August.

Convention.—A brief account of the nineteenth general convention of the German Association of Central Stations, which was held in Kristiania. A number of regulations were adopted and papers were presented, but no abstracts of the papers are given.—*Elek. Zeit.,* Aug. 18.

BOOK REVIEWS.

LIFE OF WILLIAM THOMSON, Baron Kelvin of Largs. By Silvanus P. Thompson. New York: Macmillan Company. Two Vols. 584 + 712 pages, illus. Price, $7.50.

This is a comprehensive work in which the life of Lord Kelvin is beautifully narrated and his scientific achievements appreciated by one who is himself an acknowledged authority in physical science. The impression conveyed by a perusal of these two volumes is one of wonderment at the mental activity displayed throughout a productive career of nearly three score and 10 years. Instances without number will be found in these 1296 pages of the unremitting devotedness of an intellectual giant to the advancement of his favorite studies. At the age of 16 we find Thomson in the heart of Germany reading Fourier's "Théorie Analytique de la Chaleur" instead of his Goethe or Schiller, as his father would have preferred. On his visits to London during his long professional career, Thomson always carried his "green" book with him to jot down mathematical inspirations as they occurred on the way; and when yachting over the seas in his *Lalla Rookh,* he kept manipulating differential equations as a pastime, or pondering over hydrodynamical problems that appealed to him as an analytical investigator or as a practical seaman.

The green-backed note-books to which reference has been made formed eventually a series of not less than 100 volumes, a lasting monument indeed to "the extraordinary fertility and bewildering variety of his genius." "They generally go upstairs, downstairs, out of doors, indoors, wherever he goes," writes his grand-niece." "One entry will be in the train, another in the garden, a third in bed before getting up; and so they go on at all hours of the day and night. He always puts the place and the exact minute of beginning an entry."

The numerous letters selected for publication testify to the wide range of subjects—dynamical, physical, geodetic and cosmical—which engrossed Kelvin's attention. Among his most frequent correspondents were such leaders in the scientific world as Helmholtz, Faraday, Rayleigh, Mascart and Darwin (Sir George); and to these and others he wrote freely and candidly about difficulties encountered, modes of attack and hopes of success. These letters reveal almost in every line the power and versatility of the writer's intellect and, at the same time, the kindness of his nature and the joy which he felt in the society of those whom he looked upon as his peers.

Some of these letters lift the veil off the home-circle and disclose a harmony and happiness, scenes of domestic and social felicity, that were the fitting reward of a life of upright living and high ideals.

In every one of the 26 chapters into which the "Life" is divided we see the great mathematical physicist vigorously bent on opening up avenues of knowledge; and at the same time we see the man of culture and accomplishments extracting after the manner of the honey-bee all that is best in life and bestowing it lavishly on his friends. Gentleness, unselfishness, simplicity and humility stand out as prominent traits in a character that was rendered still more beautiful by the constant adherence to deep, religious beliefs which no new-fangled theory could ever shake. "Humility without fear" was emblazoned on his coat of arms; and these pages show that the same illuminating motto was ever the guiding motive of his conduct.

In the two chapters on the Atlantic telegraph we see Thomson, though officially holding only a relatively subordinate position, ever ready to lend the assistance of his unrivaled combination of scientific knowledge with practical skill to the electrician in charge, helping him to solve the puzzling difficulties that arose with such provoking frequency in the submergence as well as in the operation of the cable of 1858. In the 39 pages devoted to the Baltimore lectures of 1884 we find the sexagenarian philosopher discussing with undiminished enthusiasm the fundamental problems of molecular dynamics before an assembly of 21 distinguished physicists whom he fondly called his 21 coefficients; and lastly in the 47 pages recounting the various incidents of the celebration of his golden jubilee as Professor of Natural Philosophy in the University of Glasgow, 1896, the representative of British science is depicted as receiving the homage of the united academies of the world with all the courtesy and simplicity of his lovable nature. It was on the occasion of these festivities that Lord Kelvin used the word *failure* as best characterizing the strenuous efforts which he had made during 55 years for the advancement of science, saying: "I know no more of electric and magnetic force, or of the relation between ether, electricity and ponderable matter, or of chemical affinity, than I knew and tried to teach my students of natural philosophy 50 years ago in my first session as professor."

Professor Thompson in commenting on this frank and startling confession points out that it sounded no note of despair nor even of pessimism; and in corroboration of the statement he quotes from a letter which Lord Kelvin wrote at the time to M. de Fonvielle in which he says: "It was not anything that I had been in the habit of teaching either in my lectures or published papers to which I referred. . . . What I feel that I have failed in has been my persevering efforts during 50 years to understand something more of the luminiferous ether and of the manner in which it is concerned in electric and magnetic forces; and it was of this that I said I know no more now than I knew 55 years ago, when I became convinced that ether was concerned in all these actions."

To the account of the life and life-work of Lord Kelvin given in the text the author adds numerous foot-notes of historic, scientific and bibliographical interest; a few of them are also well seasoned with wit and humor.

The work contains 16 plates, among which are four photogravures of the illustrious scientist. Appended to the second

volume are: (1) A list of distinctions, academic and others; (2) a list of printed books, 25 in number; (3) a list of scientific communications and addresses, 661 in all; and (4) a list of patents.

To Prof. Silvanus P. Thompson the students and admirers of Lord Kelvin all the world over owe a deep debt of gratitude for a "Life" of the great leader that is as ennobling and inspiring as it is terse in style and informing in matter.

Les Oscillations Electromagnetiques et la Telagraphie Sans Fil. By Prof. Dr. J. Zenneck. Paris: Gauthier-Villars. Two volumes, 994 pages, 802 illus. Price, 34 francs.

This translation from the German by P. Blanchin, G. Guerard and E. Picot, officers of the French Navy, puts Zeneck's "Electromagnetic Waves" (Elektromagnetische Schwingungen und Drahtlose Telegraphie") into a form which many engineers will find more convenient than the original. The translators have made an almost literal rendering of the German edition of 1905, but have corrected it, with the author's permission, up to February, 1908.

Dr. Zenneck prepared this work from the material of his lectures at the University of Strassburg and so wrote it that it appeals especially to those who wish a thoroughly comprehensive reference book on wireless communication. The book aims to cover the physical principles underlying the art, and yet does not require an extended mathematical training on the part of the reader. Except in the treatment of oscillations, geometrical and simple physical demonstrations are used rather than the calculus; and even where calculus is used, the reader need have a knowledge of its rules only. However, for those who wish the more strict physical and mathematical developments, the author has included a number of theoretical notes.

Since the book treats of the fundamentals which form the basis for the careful design of instruments for ether communication and does not attempt to follow the rapidly changing detail of apparatus, it will be of value long after existing appliances have been discarded. It is possible that the partial disregard of instruments as actually arranged has led to slight historical inaccuracies—for example, Fessenden is not credited with his original work on the liquid barretter (electrolytic cell detector)—but this cannot detract from the clear presentation from the physical viewpoint. It is also possible that the author's estimates will not always coincide with those of his readers, but that can do no harm.

The French edition is published in two volumes, the first covering alternating currents of low frequencies and closed high-frequency oscillators, and the second taking up open oscillators for high frequencies, coupled circuits, wireless telegraphy and electromagnetic waves. The "technical alternating currents" are treated thoroughly, and the properties of high-frequency currents are deduced from the similar low-frequency effects, making due allowance for the changes which occur as the period is shortened, and considering the cases of damped oscillations. Under the topic of wireless telegraphy different transmitting and receiving arrangements, and six classes of wave detectors, are thoroughly discussed. The last chapter considers electromagnetic waves after the manner of light, and light waves as electromagnetic oscillations. At the end of the book are a number of tables and curves giving electrical relations which should prove very useful in the calculations which are common to wireless work.

As a whole, the work forms a valuable addition to the library of the wireless engineer and the student of electromagnetic waves.

Prinzip und Wirkungsweise der Technischen. Messinstrumente für Wechselstrom. By Fritz Hoppe. Leipzig: Johann Ambrosius Barth. 86 pages, 114 illus. Price, 4 marks.

This book is Vol. IV of the author's electrotechnical series of text-books, and is devoted to the description of the fundamental types of alternating-current instruments. It includes the following types: Moving iron, or electromagnetic; hot wire, electrodynamometer and electrostatic. Special chapters are devoted to phase indicators, oscillographs and frequency indicators. Mathematics are avoided and explanations are accompanied by line drawings and diagrams which assist materially in making the principles of operation clear. The meters described are all of German design, but so far as the types are concerned the descriptions are of universal application. The treatment of frequency indicators is conspicuously German, since only the resonant vibration type is described, which type is seldom used on this side of the water. The differential coil type, so largely used here, is not mentioned.

The Mechanical World Electrical Pocketbook. 1910. Manchester: Emmott & Company, Limited. 175 pages. Price, 6d.

This is a companion to the *Mechanical World* Yearbook and is suited to the needs of mechanics and electricians. It contains very short descriptions of various apparatus, and gives directions for the wiring and installation of apparatus, testing of circuits and making simple measurements. The wiring is, of course, in accordance with the British regulations and therefore does not in all respects apply in this country. There is little tabular data in this book that cannot be found in any engineering handbook. As a useful reference book, this is far behind its companion, the Yearbook.

New Apparatus and Appliances

FLAMING-ARC LAMPS IN TUNNEL CONSTRUCTION.

By L. J. Auerbacher.

The New York aqueduct system, now in course of construction, furnishes many opportunities for the use of electricity for motors and lamps. Owing to the fact that most of the lighting is for outdoor use and for the illumination of large areas, naturally the flaming arc is the most efficient lamp to use. The Pittsburgh Contracting Company, which is constructing Section 52 at Elmsford, N. Y., in addition to using the flaming arc for lighting around shafts, stone crushers, pits, etc., has experimented with great success with flaming arcs for tunnel lighting. Mr. L. C. Brink, superintendent, together with Mr. F. A. Raven, electrician of the Pittsburgh Contracting Company, installed several Hawthorn flaming arcs in the tunnel. This type was selected because of its simple construction and its ability to withstand rough usage without getting out of order. The current is 60 cycle, alternating, and each lamp is connected in multiple on 110 volts in connection with an autotransformer. The lamps are installed at the bottom of the hoist, at loading platforms near the drilling gangs, and at intervals of 150 ft. along the tunnel, which is 20 ft. high and 17 ft. wide.

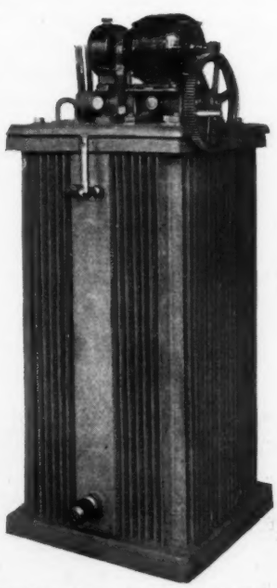
Before a blast is set off the nearest lamp is easily removed and later it is again hung on the support. This lamp is connected with the circuit by a flexible stage cable.

The contractors have found this scheme a great help, as the golden yellow light readily penetrates the foggy atmosphere of the tunnel and brilliantly lights up all parts. In fact, daylight working conditions exist 200 ft. below ground, which is a great advantage in expediting the work.

The Western Electric Company, manufacturer of the Hawthorn flaming arc, reports many sales to large contractors, who find the simple and rugged design of the Hawthorn lamp extremely well adapted to these conditions.

INDUCTION-TYPE, POTENTIAL REGULATOR.

The motor-operated, single-phase, induction regulator shown by the accompanying illustration embodies the several improvements recently made in this line by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. Although the general design of these regulators remains unchanged, modifications have been made that insure not only a higher degree of satisfactory operation but longer life. The skeleton frame construction of the new type single-phase, potential regulator permits the use of a "cast-in" corrugated, sheet-metal tank, which affords a larger and more efficient radiating surface than the cast-iron tanks used with the earlier regulators, thereby insuring a low operating temperature. This type of tank is also less liable to give trouble from oil leakage, which sometimes occurs with the cast-iron tanks on account of unavoidable defects in the castings. In the latter, the leaks usually developed after the punchings and windings had been placed in position, thus causing considerable loss of labor in the work of rectification, while it is noteworthy that in the case of the "cast-in" tank a defective tank entails no other loss than the tank itself. In the earlier designs, the cast-iron tank was bored out to receive the stator punchings. As this tank was open only at the top, difficulty was sometimes experienced in obtaining inner cylindrical surfaces which would be in perfect alignment with the rotor bearings located in the cover and bottom of the tank.

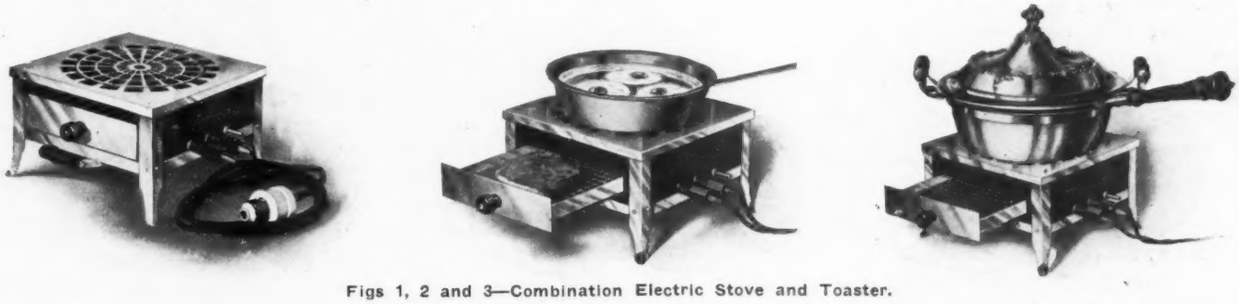


Induction Type Potential Regulator.

Up to and including the 95-kw size, the polyphase regulators have "cast-in" corrugated, sheet-metal tanks. They are similar to and possess all the advantages of the "cast-in" type of tank. They have, it is claimed, great strength mechanically, large radiating surfaces and have dirt and dust-proof qualities. An oil gage at the top and a valve as oil drain at the bottom are provided. Above 95 kw the regulators are usually oil insulated and water cooled. Boiler-iron cases with cast-iron bases and covers are usually used. The single-phase regulator has an inherent tendency to vibrate, but this has been overcome in the Westinghouse regulator by a careful design of the bearings and shaft. The moving element is carefully centered so that a uniform air-gap is secured. Furthermore, the tendency to vibrate is reduced due to the low point on the saturation curve at which the magnetic circuit of the regulator is worked. A very agreeable result of the elimination of the vibration is the noiseless operation of the regulator.

COMBINED ELECTRIC STOVE AND TOASTER.

In the new electric cooking device illustrated herewith a double use is made of the heat. Cooking can be done on top of the stove at the same time that toast is made on the toaster in the little drawer which slides in and out in the body of the device. One operation does not interfere with the other. The heating coils are underneath the openings on top of the stove and above the toaster in the drawer. The heating coils are made interchangeable, so that in case of accident or burn-out they may be readily replaced. Three degrees of heat are provided, consuming respectively 250 watts, 375 watts and 550 watts. The device is attractive in appearance and is finished either in black or polished nickel. By its use the breakfast eggs or cereals may be cooked on top of the stove at the same time that the toast is browning in the toaster. The device also lends itself readily for use with a chafing dish. It is made by the M-V-W Electric Manufacturing Company, Reed City, Mich. Mr. George D. Westover, an electrical man of experience, is president of this company.

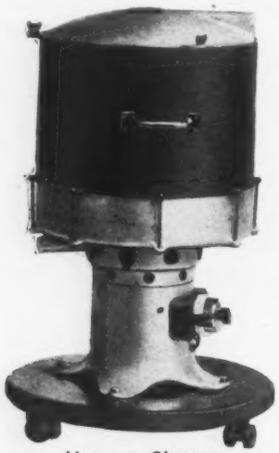


Figs 1, 2 and 3—Combination Electric Stove and Toaster.

PORTABLE ELECTRIC VACUUM CLEANER.

The Electric Renovator Manufacturing Company, of Pittsburg, Pa., which has produced several very successful portable vacuum cleaners of various sizes to suit all sorts of requirements from cleaning in large hotels and office buildings down to a moderate-sized dwelling, has brought out a portable machine, the "Invincible Junior," constructed on the centrifugal principle, which has proved to be especially applicable to vacuum cleaning. The motor and the fans are mounted on the same vertical shaft. As may be seen from the illustration, the dust collector is at the top; the fans are beneath the dust collector and the motor is at the bottom. As the motor is the heaviest part of the apparatus, this arrangement gives the greatest stability. The air is received at the very top of the machine and is drawn down through the dust receiver where all the dirt and dust are removed. It then passes through the centrifugal fan and is discharged into the atmosphere. The elimination of the dust before passing the air through the fans is a great gain in increasing the life of the bearings, as there is no chance whatever for dust to get into them and cut the linings. There are no rubbing parts beside the bearings in this machine, and there is practically no noise and no wear; this, of course, means small expense for repairs. The flow of air and power consumption adjust themselves automatically to the requirements

of the work. The power required—about ¼ hp at full load—is delivered by a Westinghouse motor. The motor has been especially designed for this class of service by the Westing-



Vacuum Cleaner.

house Electric & Manufacturing Company, Pittsburgh, Pa. The entire equipment weighs about 65 lb. and is capable of exhausting 50 cu. ft. of air per minute.

CONTROLLERS FOR ALTERNATING-CURRENT CRANE MOTORS.

The use of alternating current and of alternating-current motors has been rapidly extended. Until recently direct-current motors only were used for crane work, and it has been necessary to furnish direct current in many plants by the use of a motor-generator set. The slip-ring alternating-current motor has characteristics which make it practicable for use with cranes, when provided with proper controlling apparatus. The Cutler-

Fig. 1—Front View of Radial Arm Type Controller.

Hammer Manufacturing Company, of Milwaukee, realizing that the use of alternating-current motors is desirable and an advantage, in some cases, has developed a line of alternating-current crane controllers, which are similar in appearance to the Cutler-Hammer direct-current controllers, as the accompanying illustrations show.

The fronts are made of high grade Vermont slate, ground to a uniform thickness and carefully inspected and tested for traces of iron. The resistor used in both types is made up of

Fig. 2—Rear View of Radial Arm Type Controller.

units; in the small controller spool units are used, while the grid unit is used in the larger. The removal of a unit can be accomplished without disturbing others. The small circular-faced controller is self-contained and compact, having the resistance mounted on the back of the face plate. It can be operated from the floor by means of ropes, making it especially serviceable for use with small cranes, as in foundries, etc. The resistor for the larger type is mounted below the face place. The straight lever motion allows of easy operation and makes convenient the installation of several controllers side by side. When desired the operation can be accomplished by a bell crank and link arrangement, placing the controller at the rear or outside of cab if desired. The steel framework, supporting the controllers, combines strength and lightness and allows easy inspection and access. The contact segments are made of hard drawn copper. The screws securing them to the face plate are countersunk beneath the surface to insure a smooth and full contact. The segments can be replaced without interfering with any connection. The contract fingers are of drop-forged copper and provided with springs, arranged to give the best contact possible. Although the squirrel-cage induction motor is not well adapted for operation of cranes, yet it is sometimes

Figs. 3 and 4—Front and Rear Views of Crane Controller.

required and the Cutler-Hammer Manufacturing Company has therefore designed controllers for this purpose also. In connection with the development of these alternating-current controllers a line of brake solenoids has been developed which cut down the starting current and reduce the mechanical wear on the brake mechanism.

WATER RECORDER FOR BOILERS AND ENGINES.

The instrument for measuring and recording graphically the water delivered to boilers or condensed from engines and turbines, illustrated herewith, has been extensively used in British central stations. Its operation is based on the law of the flow of water over weirs and notches, and it employs the sharp-edged V-notch of Prof. Jas. Thompson, which form is better adapted for measuring small quantities of water than the horizontal weir or circular orifice. Another property of the notch is that its angle may be varied without impairment of efficiency, so that very small quantities of water may be measured, since the

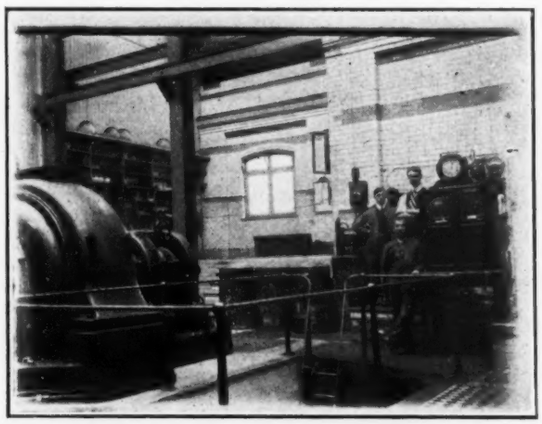


Fig. 1—Combined Indicating, Recording, and Counting Instrument for Measuring Steam Consumption.

height of the head may be materially increased without adding very greatly to the flow if the width be decreased. In the recorder illustrated, which is manufactured by the Lea Recorder Company, 28 Deansgate, Manchester, England, a selection from notches of many different angles may be made according to the quantity of water to be measured. The recorder is actuated by a float which rises and falls with the level of the water in the V notch. Fig. 2 shows a longitudinal elevation of the apparatus, and Fig. 3 a transverse sectional elevation through the float chamber, which is in communication with the still water above the weir by means of a 1-in. pipe, controlled by a valve. By this means surface agitation of the water in the tank, affecting the float, is prevented. The float is usually made about 12 in. in diameter, and is connected to the recording instruments by means of a rod or spindle. The latter passes through an anti-vapor gland, and is connected to and actuates a rack, shown in Fig. 4, which gears with a small pinion that in turn actuates a cylinder upon the surface of which is a spiral groove. In this groove, the curve of which is calculated to accord with the character of the final record, travels a pin on the pen arm. It will be evident from the foregoing that as the float rises a rotary motion is imparted to the drum, which by means of the spiral on its surface, and a saddle arm, causes the pen to trace a line on the recording cylinder or drum. A scale shown on the left-hand side of Fig. 4 indicates the actual rise and fall of the water in the tank in inches. The result of this mechanism is that the instrument can be advantageously em-

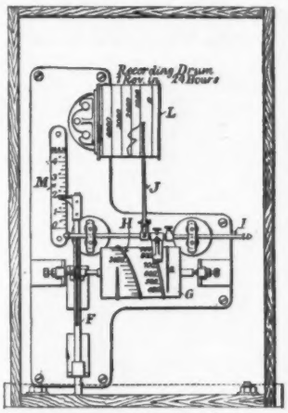


Fig. 4—Recording Mechanism.

ployed to produce daily or weekly records from which the total quantity of water passed in a given time may be easily deduced. One of the special features claimed for the apparatus is the large exaggerated scale adjacent to the coil upon the drum, which is clearly shown in Fig. 4. Where it is desirable to obtain very accurate, instantaneous measurements of the flow, as, for instance, when testing a surface condensing engine in order to determine the consumption of steam per indicated horse-power per hour, the air-pump discharge at the time being passed over the weir, this scale is most advantageously em-

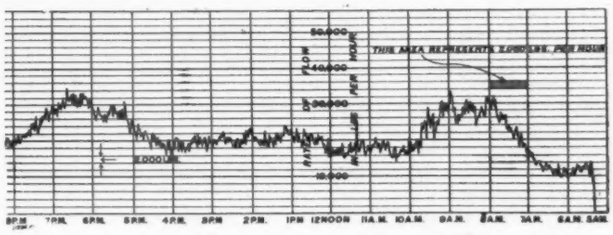
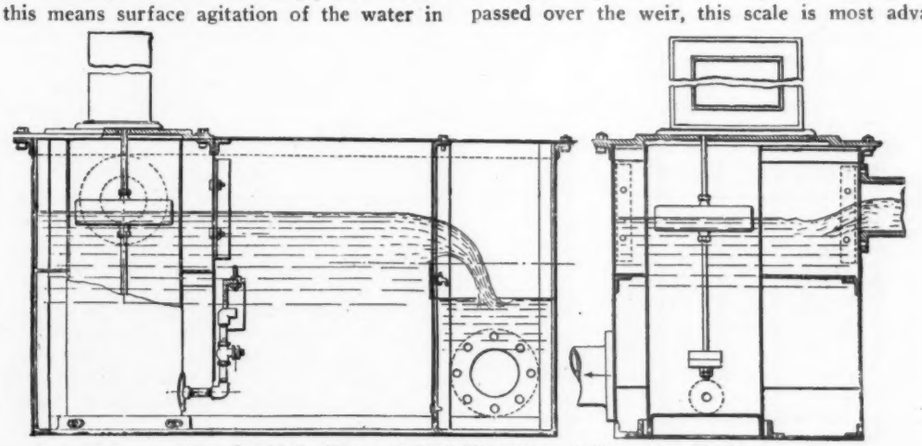


Fig. 5—Chart Made by Recorder.



Figs. 2 and 3—Side and End Elevation of Measuring Tank.

ployed. A pointer projecting from the saddle arm moves over the scale on the drum, enabling a very high degree of accuracy in observation to be obtained. It is claimed by the manufacturer that fluctuations in the float water level of 1/200 part of an inch are easily observable. In an instrument with a maximum movement of float of only 4½ in. the scale on the drum is about 20 in. long. Fig. 5 is a reproduction of an actual chart made by one of these machines in an English central station, the consumption of water by the engine being 17.5 lb. per kw-hour.

Industrial and Commercial News

The Week in Trade.

REPORTS of the conditions of trade varied considerably last week, according to the sections reporting. There were many cross currents and side influences affecting local situations. As a rule, however, it is not too much to state that the general condition of business was distinctly improved. This was not only true with regard to retail trade, but an improvement was also observable among the wholesalers and jobbers. The advance of the season to the point where purchasers are receiving returns for the marketed crop always brings about a rejuvenation in business. While there is an increase of activity in a few Southern centers, this section of the country is more backward than any other at the present time, owing to the fact that the cotton crop is one of the last to be harvested and marketed, and all those sections which depend for their yearly income upon wheat and other small grains have already received the money for their crop and are consequently reviving in business. The corn crop and the cotton crop have yet to be marketed. There is every reason to believe, however, that the sections which depend upon these crops will eventually be as well provided with funds as those which depend upon small grains. As heretofore noted, the number of buyers in central jobbing cities is unusually large. These buyers have to a considerable extent displayed conservatism, but this does not mean that they are not placing fair orders with the wholesalers. It is pretty well understood that the shelves of retailers throughout the country are fairly bare of stock, and therefore purchases must be more liberal than they were last year. There continues to be some irregularity among the leading industries. There is more doing in iron and steel, but prices are lower. The textile industry is still curtailed. At the present moment there are very few labor troubles affecting the industrial world and it does not seem probable that any general demand for increased wages will be made under present trade conditions. Collections have been materially improved, due largely to the fact that many sections have received their money from the marketed crops. Business failures for the week which ended Sept. 1, as reported by *Bradstreet's*, were 179, against 235 the previous week; 166 for the same week in 1909, 210 in 1908, 130 in 1907 and 121 in 1906.

The Copper Market.

PRICES for copper were maintained last week, both in this country and Europe by the allied producing and selling interests. This was not accomplished, however, by any legitimate condition of supply and demand, but by the financial strength of the interests back of the market. During the short market week which preceded the holidays the buying, both here and abroad, was extremely light. Consumers apparently have their wants well enough supplied for all immediate needs and are not anxious to purchase at the present range of prices. With the steel industry operating at considerably below capacity it is the general opinion that the actual consumption of copper will show some reduction. Although this is the time of year when electrical railways generally place liberal orders for equipment and repairs in preparation for the winter traffic, there has very little of this business been announced as yet. Preliminary estimates of the figures of the Copper Producers' Association for August, which will be made public this week, indicate that there will be a small addition to the surplus stocks carried. While there has been a great deal of talk of curtailment, it is not believed that production has been materially reduced. Imports have continued to be heavy, while both exports and domestic takings have been light. Total exports for August, as figured by the producers, will not be more than 25,000 tons, although the Metal Exchange figures place the shipments at 27,976 tons. Exports since Sept. 1 have been insignificant. Standard copper was quoted in the Metal Exchange Sept. 2 as per accompanying table.

Standard copper:	Bid.	Asked.	Settling price.
Spot	12.15	12.25	.....
September	12.15	12.25	12.20
October	12.15	12.25	12.20
November	12.20	12.30	12.25
December	12.25	12.35	12.30

The London market Sept. 2 was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	55 6 3	55 7 6
Standard copper, futures	56 2 6	56 5 0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	11.70c
London, spot	£62 0 0	£52 15 0
London, futures	65 18 9	53 7 6
London, best selected	65 10 0	57 15 0

Industrial and Commercial Notes.

Tungsten Lamps Abroad.—H. M. Hirschberg, president and manager of the Excello Arc Lamp Company, has recently returned from his annual trip to Europe. Mr. Hirschberg says that he found the conditions of electrical trade in Germany and generally on the Continent considerably better than in this country. The factories seem to be busier and the demand for electrical goods and electrical appliances he thinks is better. He says that the flaming arc lamp is being taken up very largely by municipalities for street lighting and that it is growing in popularity in this direction all the time. Another thing which he observed in Germany was the almost universal use of tungsten lamps. He declares that the use of carbon filaments in German cities has been almost discontinued. Every one uses tungsten. On the majority of the railroads in Germany tungstens are used for car lighting. Mr. Hirschberg is of the opinion that the coming season will see a great advance in the use of flaming arcs in this country.

Demand for Mining Machinery.—The Allis-Chalmers Company's record for August shows that there is no diminution in the demand for any of the lines of machinery that the company produces, and the bookings for the month show substantial gains over last year from almost every portion of the United States and Canada. One feature in the increasing demand is the growth in orders for mining machinery. One recent order of this kind was placed by the Ray Consolidated and Chino Copper companies which included four triple-expansion engines of 2500 hp each, as well as 1,000,000 lb. of transmission machinery. Other important orders were American Steel & Wire Company, 1200-hp motors and motor generators; Minnesota State Prison, three reciprocating engines with generators and 56 induction motors, and the St. Lawrence Flour Mill Company, of Montreal, complete motor equipment with a capacity of 1500 bbl. of flour per day.

Duplex Metals Company.—The Duplex Metals Company, of 149 Broadway, New York, reports that there is a continued increase in the demand for copper-clad wire for use in telephone and open distribution work. According to a representative of this company, No. 14 copper-clad steel wire is rapidly replacing No. 12 hard-drawn copper wire for open line distribution and short haul telephone work. This authority also shows that No. 17 copper-clad steel twisted pairs is now almost a universal standard for distribution purposes. This eliminates all bridling both at arrester, cable head and distributing box. On account of its small gage it is claimed that the saving is considerable in rubber installation over the old No. 14 hard-drawn copper twisted wire. The Duplex Metals Company has furnished a great portion of the wire used by the Great Northern Railroad in the telephone system which it has recently established for train despatching.

Public Service Corporation of New Jersey.—The Public Service Corporation of New Jersey has taken title to five acres of land at Tottenville, S. I., and has practically closed negotiations for an adjoining 10-acre tract. The company has announced its intention of building two ferry houses on the tract at Tottenville, and will establish a ferry service between that point and Perth Amboy. It also contemplates the erection of a $1,000,000 power house at Perth Amboy, which will furnish energy for that section and other points in Staten Island. This new work on the part of the Public Service Corporation places it in direct competition with the Staten Island Rapid Transit Company, which has heretofore had a monopoly upon the island.

Montreal Street Railway & Power Merger.—The buying of stock of the Montreal Street Railway Company, which started early in the year and has continued to the present, has led to persistent rumors in financial circles in Montreal that the Canadian Power Company has secured control of a majority of the stock of the railway company. The directors of the Montreal Street Railway Company have taken official cognizance of the rumors by addressing a circular to the shareholders of the railway company, stating that owing to the persistent rumors and repeated statements in the financial columns of the newspapers regarding a proposed amalgamation of the railway company with a new hydroelectric power company the directors requested the shareholders to withhold their proxies until a careful investigation could be made of the proposed scheme. The circular stated that the directors have under consideration certain negotiations and plans affecting the future of the Montreal Street Railway Company, which will be laid before the shareholders in a short time. The issuance of the circulars is taken to mean that negotiations are under way for an amalgamation of the railway company with the Montreal Light, Heat & Power Company, but it is now expected in financial circles that at the annual meeting of the street railway company in November it will be found that the Canadian Power Company interests have obtained a majority of the stock of the railway company and a change will take place in the directorate of the railway company.

Wabash River Power Company.—The assets of the Wabash River Power Company, located at the grand rapids, near Mount Carmel, Ill., formerly owned by Fort Wayne (Ind.) capitalists, have been purchased by a syndicate of Illinois, New York and Colorado financiers. Mr. J. B. Blackman, a wealthy banker of Harrisburg, Ill., is largely interested and with him are associated J. J. Henry, widely known in the development of hydroelectric properties through the West, and G. E. K. Hixson, who with others is engaged in the construction of an electric railway through the southern part of Illinois. The engineering company has not been definitely decided upon. Now that these water power holdings are in the hands of gentlemen who are experts in the development of water power, who have at their command sufficient capital, there will be no time lost in the complete development of the power of this vast body of water that has never been utilized, even since the construction of a dam at that place by the national government. The dam, which was built under the supervision of and at the expense of the United States Government, is 1185 ft. in length, having a fall of 11½ ft., and when the work of lowering the river bed below the dam, for which there has been an appropriation made by the government, is completed, the fall will be 17½ ft.

United States Lighting & Heating Company.—D. W. Pye, formerly vice-president of the Safety Car Heating & Lighting Company, who was recently elected a director of the United States Lighting & Heating Company, was last week elected president of the latter company and took up the duties of his office Sept. 1. The financial condition of the United States company is very satisfactory. The company has absolutely no indebtedness of any description, either bonded or floating, and a statement made on June 17 last showed that at that time it had on hand quick assets amounting to about $1,250,000, exclusive of its real estate, plant machinery and other property. The new plant of the company at Niagara Falls is rapidly approaching completion and the officials expect that the business will be finally established there early in the coming year, giving the company a capacity of approximately 6½ times its present output. Within the past 60 days the company has been unable, owing to the amount of unfinished orders on hand, to accept new business, except such as already had been secured under contract during the preceding six months. The dividends of 1¾ per cent quarterly are being paid upon the preferred stock, on which there is outstanding $2,500,000.

Electrification of the Long Island Road.—In connection with the opening of the East River tubes, service in which will begin this week, Ralph Peters, president of the Long Island Railroad Company, announced last week that the work of electrification upon the north shore division beyond Woodside would not be begun until all grade crossings had been eliminated.

Athens (Ga.) Gas, Railway & Electric Company.—The Athens Gas, Railway & Electric Company, which was recently formed to take over the properties of the old street railway system, is preparing to extend its lines so as to take in an immense amount of territory that is not now served by traction lines. The management of the company is also pushing toward completion as fast as possible the dam and power house of the new plant at Barnett Shoals. It is stated that when completed this plant will afford the city of Athens ample power for lighting and street railway service for a number of years to come, and it will at the same time afford power for a large cotton mill with about half a million spindles, which is now projected.

Canadian Power & Paper Company.—The *Canada Gazette* contains the announcement of the incorporation of the Canadian Power & Paper Company, with a capital of $10,000,000. As the incorporators are the persons connected with the legal interests who have acted in the past for many of the enterprises of Messrs. MacKenzie & Mann, it is believed that these gentlemen are at the back of the undertaking. The powers granted are of the most extensive character and give the new company broad authority over their new enterprises, except where the interests of municipalities are concerned, in which case contracts must be submitted for confirmation by the municipalities.

Ottawa Municipal Plant Lets Contracts for $60,000.—The Municipal Electric Commissioners of Ottawa, Ont., have awarded the following contracts, aggregating about $60,000, for the new power conduit to be built from the Chaudiere Falls to the distributing station on Laurier Avenue: Transformers, Canadian General Electric Company, $12,000; cable, British Insulated Cable Company, Montreal, $16,246; conduit pipes, Eadie-Dougle Company, Ottawa; manhole covers, J. B. Maclaren, 2¼ cents per pound for cast-iron. For the most part the conduit will be placed under the boulevards, and the work of laying the pipes will be done by the city engineer by day labor.

Denver Federal & Light Equipment.—Sanderson & Porter, of New York City, have recently contracted with the Westinghouse Electric & Manufacturing Company for two 1250-kva, 2300-volt, three-phase turbo-generators to be used in the power plant of the Federal Light & Traction Company, Denver, Col. Two La Blanc condensers will be used in connection with the steam turbines. The generator fields will be excited by two 50-kw, 125-volt, 2250-r.p.m. direct-current turbo-generators to be used in connection with a Tirrill regulator. The order also includes the necessary transformers, lightning arresters, disconnecting switches and switchboard.

Electric Smelting & Aluminum Company.—Ground has been purchased at Woodbridge, N. J., by The Electric Smelting & Aluminum Company, of Lockport, N. Y., on which it is intended to build a large factory. Arrangements are also being made for constructing a dock and for securing railroad connections. The company will also erect houses on its property for its employees. The Electric Smelting & Aluminum Company is devoted to the manufacture of aluminum alloys and has been in business at Lockport a number of years.

Electricity for Woolen Mills.—The Woodside Woolen Mills, of Northboro, Mass., have recently been equipped with electric motors for individual drive operation. Energy is furnished by the Marlboro Electric Light Company. It is said that the new power which was turned on more than a week ago is giving great satisfaction and promises to work considerable economy. The boilers of the old steam plant will be used to furnish steam for the washing and drying of the raw wool.

Electrical Vehicle Association.—Among the directors of the Electrical Vehicle Association, which was incorporated in New York recently, as referred to in our issue of Sept. 1, are: William H. Blood, Frank J. Stone, Boston; Hayden Eames, Cleveland; Charles Blisard, Philadelphia; Herbert H. Rice, Indianapolis; W. W. Freeman, Brooklyn; Frank J. Gyer, Orange, N. J., and Arthur Williams, Henry C. Cushing, Jr., and Hainey Robinson, New York City.

Isthmian Canal Proposals.—The General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., will receive proposals until Sept. 10, for two 35-hp compound-wound, direct-current, 110-volt motors, and 5000 ft. of 300,000 circ. mil single-conductor stranded lead-covered cable.

Railway Equipment.—The Capitol Traction Company, of Washington, D. C., has recently entered an order for 20 double equipments of Westinghouse No. 306, 50-hp, 500-volt railway motors and 20 equipments of double-end K-27 control.

Financial.

The Week in Wall Street.

THE short week in Wall Street, which concluded Sept. 2, was one of the dullest ever known in the history of the Street. For several days the average transactions were only about 200,000 shares. As far as could be observed, there was absolutely no outside interest in the market and the trading that was done was entirely professional. It is said that business was so slack and that trading was so highly professional that commission houses were glad to accept orders from small dealers who wanted to buy or sell odd lots. As far as the wire trading is concerned, which means the general commission orders of the country, there was absolutely nothing doing. Many of the large houses, which in prosperous times do a business of 100,000 shares a day, did less than 5,000 shares a day last week, and the absence of tenants in the handsomely furnished "Customers' Rooms" was one of the jokes of the Street. United States Steel, Reading, Union Pacific and to some extent the Interborough issues practically covered the trading. On many stocks there was not a quotation for days. The exact reason for this extreme dullness was hardly apparent. Mr. Roosevelt's tour and the tenor of his speeches throughout the West is held responsible for checking any general interest in the market. It is not so much that the Street is afraid of what Mr. Roosevelt may accomplish, but that as it is generally apathetic, it is entirely willing to wait until there seems a more favorable opportunity for investing. The money market continues to be in the same condition as has been noted for a number of months. There is little investment demand for bonds, and on this account many large enterprises which have been projected are being held up, waiting for a better chance to place new securities. Rates for money in the banks are still easy for call loans and there is no trouble about these being made on suitable collateral. Rates for time money, however, are not much cheaper than is usual at this period of the year, which indicates that banks, while well supplied with funds, are not seeking loans that will tie up cash for any long period. Quotations Sept. 2, the last day before the holidays, were call, 1¼@1¾ per cent; 90 days, 3¾@4 per cent.

NEW YORK.

	Aug. 29.	Sept. 2	Shares sold.		Aug. 29.	Sept. 2	Shares sold.
All.-Ch.	8⅞*	8⅞*	———	Int.-Met., pfd.	48½	49½	5,400
All. Ch., pfd.	32	32	100	Mackay Cos..	85	85	200
Amal. Cop...	64¾	63½	46,500	Mackay C., pf	73¾*	74½	100
Am. D. T....	20½*	20½*	———	Man. Elev...	131*	131*	———
Am. Loc.....	35	34¾	1,250	Met. St. Ry..	15*	15*	———
Am. Loc.,pfd.	103½*	103⅜	240	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	71¼*	71¼	———	Steel, com...	70½	68½	315,925
Am. T. & T..	134½	135	5,845	Steel, pfd...	116⅛	116¼	4,740
B. R. T.....	74¾	74½	8,610	W. U. T.....	61½*	62½	1,182
Gen. Elec....	142⅞*	141¾	10	West'h., com.	59	59	700
Int.-Met.	17¾	18½	7,000	West'h., pfd.	110*	110*	———

PHILADELPHIA.

	Aug. 29.	Sept. 2.		Aug. 29.	Sept. 2.
Am. Rys.....	44	44*	Phila. Elec.....	15	15
Elec. Co. of A.....	11¼	11¼*	Phila. R. T.....	18⅛	17¼
Elec. St. B'ty.....	47½	46½	Phila. Trac.....	83⅜*	83¾
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	44⅞	42⅜

CHICAGO.

	Aug. 29.	Sept. 2.		Aug. 29.	Sept. 2.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	118	118*
Chi. Rs., Ser. 1.....	70*	70*	Met. El. Co.....	15*	17
Chi. Rs., Ser. 2....	16	16½*	Met. El., pfd.....	60*	59
Com. Edison.....	111	111	Nat'l Carbon.....	120	120*
Chi. Subways.....	4⅞*	4⅝	Nat'l Car., pfd.....	117*	117*

BOSTON.

	Aug. 29.	Sept. 2.		Aug. 29.	Sept. 2.
Am. T. & T.....	134½	135	Mex. Tel.....	5¼*	5⅛
Cum. Tel.....	144½*	144½*	Mex. Tel., pfd.....	6¼*	6¼*
Edison E., Ill.....	260	260	N. E. Tel.....	129¾*	130*
Gen. Elec.....	144⅜*	141½	W. T. & T.....	15*	15*
Mass. E. Ry.....	17⅜	18	W. T. & T., pfd.....	83	83*
Mass. E. Ry., pfd...	82	82			

*Last price quoted.
Shares sold for five days, Aug. 29 to Sept. 2.

Financial Notes.

Cities Service Company.—The plan for the long-talked of holding company which has been in process of organization by Henry L. Doherty & Company for several months has finally been announced. The company is known as the Cities Service Company and was incorporated last week under the laws of Delaware. The authorized capitalization of the company is $50,000,000, to be divided into $30,000,000 6 per cent cumulative preferred and $20,000,000 common stock. The common stock has been all issued and when the transfers for the issues of the subsidiary companies that will be first taken into the combine are made there will be about $5,000,000 at once put in use. Of the remainder there has been set aside to be used for corporate purposes, within the discretion of the board of directors, $500,000, which will leave a remainder of $14,500,000 of common stock in the treasury to be used for the acquirement of additional properties. It is announced that this holding company will take over as the basis of its organization the Denver Gas & Electric Company, the Empire District Electric Company—which in itself is a combination of properties doing business in the neighborhood of Joplin, Mo.—and the Spokane Gas & Fuel Company. It is stated in the circular setting forth the plan of the new holding company that after consultation with a majority of the stockholders of the above-named companies the following basis of exchange has been decided upon: 1 8/10 shares preferred Cities Service Company and 9/10 of one share of common stock Cities Service Company for each single share Denver Gas & Electric Company; ½ of one share preferred of the Cities Service Company and ¼ of one share of common of the same company for each share of the common stock of the Empire District Electric Company; 3/10 of one share of preferred stock of the Cities Service Company and 15/100 of one share of the common stock of the same company for each one share of the common stock of the Spokane Gas & Fuel Company. It is announced that in addition to the stock offered above for transfer $1,000,000 of preferred stock and $500,000 of common stock have been underwritten for a consideration of $1,000,000 in cash for the purpose of providing the holding company with ample working capital. Henry L. Doherty & Company are to act as bankers and syndicate managers for the new company and will be paid for their services only in common stock. When the stocks of the Cities Service Company, as explained above, have been issued there will be outstanding; preferred, $8,779,650; common, $4,889,825. The balance of the securities are to be retained by the company for the acquirement of additional properties. As forecasted in the *Electrical World* July 21, this new holding company of the Doherty interests contemplates taking over quite a number of other properties in addition to those that have here been named. These include the Lincoln (Neb.) Gas & Electric Company and the Knoxville (Tenn.) Gas & Fuel Company. The Montgomery (Ala.) Light & Water Power Comopany, the Meridian (Miss.) Light & Railway Company and several other properties will probably be eventually included. Henry L. Doherty will be president of the company and his management will be much the same as that which has heretofore controlled the Doherty interests. There will be no bonds issued by the holding company, but the interest and principal of the underlying bonds of the subsidiary companies will be guaranteed.

Washington, Laurel & Berwyn Railway Sold.—The Washington, Laurel & Berwyn Railway was purchased last week at public auction by George Weems Williams, acting for the Washington, Baltimore & Annapolis Electric Railway, for $75,000. The sale took place at Laurel, Md., and was under foreclosure proceedings. The road was owned by the Washington, Baltimore & Annapolis, but has been leased and operated by the Washington Traction Company. It has never been able to earn fixed charges and some time ago was placed in the hands of receivers. When the Washington, Baltimore & Annapolis decided to build between Washington and Baltimore, the Washington, Laurel & Berwyn was purchased, but those behind the new company subsequently abandoned the plan to use this property and surveyed an entirely new route between the two cities. The road was then leased to the Washington Traction Company.

Shawinigan Water & Power Company.—During the seven months which ended July 31, the returns for the Shawinigan Water & Power Company of Montreal have shown large increases over the preceding year. The company will show at the end of the calendar year the largest record in its history. In 1909 the company paid 4 per cent dividends on its $6,500,000 outstanding stock, and the same rate has been paid this year on the $7,000,000 of stock. At the present time the capacity of the company is estimated at 100,000 hydraulic horse-power, two high-tension transmission lines with a total capacity of 20,000 hp connecting the power station at Shawinigan Falls to the substation at Montreal, a distance of 85 miles.

Mexican Light & Power Company.—The July earnings of the Mexican Light & Power Company, which is owned in Montreal, show a big improvement over those of the corresponding month last year. This is largely because the company last year was suffering from a break in the Necaxa dam. The figures for July this year show a decrease in operating expenses of $234,571. The gross earnings amounted to $578,484.

Susquehanna Railway, Light & Power Company.—The annual report of the Susquehanna Railway, Light & Power Company for the year which ended June 30 shows net earnings of $748,062, an increase of $135,701 over the previous year. After paying all fixed charges and preferred dividends, there is a balance left of $293,772. During the year the controlling interest in the stock of the Wilkes-Barre (Pa.) Gas & Electric Company was acquired. The Susquehanna company is a holding concern with headquarters in New York City. It owns and controls the United Gas & Electric Company, which in turn owns and controls electric and hydroelectric power companies in Pennsylvania, Indiana, Colorado and Massachusetts. The Susquehanna company during the year spent $686,847 for extensions, additions and betterments to its various properties.

Tri-City Railway & Light Company.—At the annual meeting of the stockholders of the Tri-City Railway & Light Company, of Davenport, Iowa, which will be held in Hartford, Conn., Sept. 15, a vote will be taken on the question of issuing $20,000,000 of new bonds, to be known as first and refunding mortgage 5 per cent bonds. A mortgage will be given by the company for the purpose of securing the payment of principal and interest of the bonds. The proceeds of the issue will be used to take up the present outstanding debt and to make additions and improvements to the property.

Washington, Baltimore & Annapolis Bonds.—The interest on the $2,000,000 issue of 5 per cent terminal bonds of the Washington, Baltimore & Annapolis Electric Railway Company, amounting to about $50,000, will not be paid. The interest was due on Sept. 1, but under the terms of the mortgage the company has 90 days in which to meet the payment. The interest payment was passed by the road on March 1 last, but on May 24 the receivers were in a position to pay it. There is a plan on foot to reorganize the property with a view to lifting the receivership.

Western Union Telegraph Company.—At the office of the Western Union Telegraph Company it is said that the business for the past three months has been steadily increasing and is now in very satisfactory shape. It was denied, however, that any new deal or combination with any other company was contemplated at this time. Rumor to this effect had been current in financial circles and was held responsible for an advance of 2½ points in the stock last week.

Commonwealth Edison Bonds.—The conversion of the bonds of the Chicago Edison Company into those of the Commonwealth Edison Company has been practically completed, $4,695,000 having been taken in exchange out of the $5,000,000 outstanding. The gain in the business of the Commonwealth Edison Company is continuous and very satisfying, and its securities were never more popular than at the present time.

DIVIDENDS.

Muscogee (Okla.) Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Sept. 15.

Northern Texas Electric Company, preferred, semi-annual, 3 per cent; common, quarterly, 1½ per cent, both payable Sept. 1.

Oklahoma Gas & Electric Company, quarterly, 2 per cent, payable Sept. 15.

Providence (R. I.) Telephone Company, quarterly, 1 per cent, payable Oct. 1.

San Diego Consolidated Gas & Electric Company, quarterly, 1¾ per cent, payable Sept. 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Baton Rouge Electric Company:					
July, 1910	$9,708	$6,221	$3,487	$1,945	$1,542
July, 1909	8,351	5,538	2,813	1,951	862
Blackstone Valley Gas & Electric Company:					
July, 1910	76,059	39,431	36,628	29,913	6,715
July, 1909	73,396	40,028	33,368	29,469	3,896
Birmingham (Ala.) Railway, Light & Power Company:					
July, 1910	216,505	109,061	107,444	.....	.....
July, 1909	183,187	101,974	81,213	.....	.....
Cape Breton Electric Company Ltd.:					
July, 1910	28,876	14,407	14,469	6,182	8,287
July, 1909	26,616	15,624	10,992	6,217	4,775
Columbus (Ga.) Electric Company:					
July, 1910	38,532	17,917	20,615	17,848	2,765
July, 1909	30,650	18,570	12,080	12,712	632
Dallas (Tex.) Electric Corporation:					
July, 1910	117,270	85,473	31,797	26,842	4,955
July, 1909	103,340	68,107	35,233	28,403	6,830
East St. Louis & Suburban Railway Company:					
July, 1910	210,844	106,158	104,686	.....	266,954
July, 1909	170,250	93,371	77,879	.....	131,096
Edison Electric Company of Brockton:					
July, 1910	20,500	12,478	8,022	3,787	4,235
July, 1909	18,526	11,913	6,613	3,558	3,055
Electric Light & Power Company:					
July, 1910	6,872	5,126	1,746	814	932
July, 1909	6,243	3,746	2,497	477	2,020
El Paso Electric Company:					
July, 1910	49,351	29,557	19,794	8,215	11,579
July, 1909	46,362	29,204	17,158	8,085	9,073
Galveston-Houston Electric Company:					
July, 1910	122,097	65,989	56,108	26,609	29,499
July, 1909	109,747	62,069	47,678	21,596	26,082
Houghton County (Mich.) Electric Light Company:					
July, 1910	18,043	10,387	7,656	4,488	3,168
July, 1909	16,752	10,224	6,528	4,129	2,399
Jacksonville Electric Company:					
July, 1910	46,905	26,207	20,698	9,488	11,210
July, 1909	39,300	22,353	16,947	9,367	7,580
Keystone Telephone & Telegraph Company:					
July, 1910	94,472	47,422	47,050	24,611	22,439
July, 1909	91,020	45,533	45,487	25,802	19,685
The Lowell Electric Light Corporation:					
July, 1910	31,348	19,438	11,910	4,788	7,122
July, 1909	26,227	14,732	11,495	4,134	7,361
Minneapolis General Electric Company:					
July, 1910	88,965	35,854	53,111	30,734	22,387
July, 1909	77,543	37,263	40,280	29,563	10,717
Northern Texas Electric Company:					
July, 1910	125,943	68,147	57,796	20,273	37,523
July, 1909	109,212	59,834	49,378	17,190	32,188
Paducah Traction & Light Company:					
July, 1910	21,577	11,697	9,880	7,023	2,857
July, 1909	19,152	11,592	7,560	6,624	936
Pensacola Electric Company:					
July, 1910	24,235	13,654	10,581	5,279	5,302
July, 1909	23,461	12,604	10,857	4,305	6,552
Puget Sound Electric Railway Company:					
July, 1910	182,986	102,204	80,782	51,291	29,491
July, 1909	184,531	106,044	78,487	48,508	29,979
Savannah Electric Company:					
July, 1910	59,140	40,943	18,197	18,192	5
July, 1909	55,812	38,247	17,565	17,444	121
Seattle Electric Company:					
July, 1910	459,059	261,509	197,550	110,375	87,175
July, 1909	592,587	305,028	287,559	108,702	178,857
Sierra-Pacific Electric Company:					
July, 1910	44,802	15,353	29,449	5,977	23,472
July, 1909	42,130	14,692	27,438	5,903	21,535
Tampa Electric Company:					
July, 1910	51,507	28,901	22,606	6,711	15,895
July, 1909	47,172	30,403	16,769	4,701	12,068

General News

Construction News.

DECATUR, ALA.—Negotiations are under way for the absorption of the Morgan County Telephone Company, an independent concern, by the Southern Bell Telephone & Telegraph Company, and it is understood that upon completion of the deal a new telephone exchange will be established by the Bell company in Decatur, and the system of the Morgan company will be thoroughly overhauled.

LEEDS, ALA.—It is reported that Col. Cobb, of Anniston, is interested in the proposed construction of an electric lighting plant at Leeds.

TROY, ALA.—We are informed that the City of Troy, Ala., expects to purchase in the near future two additional 250-kw or 300-kw, 2300-volt, 60-cycle, three-phase generators and engines and two 150-hp return tubular boilers, 150 lb. gage pressure. One seven-pane distributing switchboard for single-phase distribution from three-phase generators, each panel to have a capacity of 50 amp, will be purchased at once. A. E. Campbell is superintendent of the electric and water departments.

TOMBSTONE, ARIZ.—The Tri-State Telephone Company, which recently acquired the telephone systems formerly owned by the Bisbee Improvement Company and the Douglass Improvement Company, expects to commence work at once upon the construction of a line connecting Tombstone, Bisbee and El Paso. Connections will be made at Deming with Silver City and at El Paso connections will be established with Las Gruces and Albuquerque.

LONOKE, ARK.—Work is soon to be commenced in this city, it is reported, upon a $75,000 generating plant which will furnish energy to be distributed throughout the rice fields in the vicinity of Lonoke.

LOS ALTOS, CAL.—Press reports state that J. D. Farwell, manager of the Los Gatos Ice, Gas & Electric Company, Los Gatos, Cal., has secured a contract to install an electric light and power plant at Los Altos, and that construction work is to be commenced at once.

OAKLAND, CAL.—It is reported that Fred C. Turner, city engineer, has petitioned the Board of Public Works to bond the city for the construction of an underground conduit system. The interest on the bond is to be derived from the rental of the ducts to the Central Oakland Light & Power Company, a new concern in the local field.

TAFT, CAL.—It is the intention of the Kern County Telephone Company to thoroughly overhaul its system at this place, and make it modern in every particular. The lines of the company are also to be extended.

HARTFORD, CONN.—Announcement is made at this city that at the October meeting of the directors of the Southern New England Telephone Company a formal call will be issued to the stockholders for subscription to another issue of new stock to the amount of $1,099,100, the additional capital to be used by the company to carry on extensions and improvements to its plant. The new stock will be issued to stockholders at par, and will be in the ratio of one to seven.

NORWICH, CONN.—At a recent meeting of the Norwich, Colchester & Hartford Traction Company the contract for its proposed interurban electric line was awarded to Ahern Brothers, of Norwich. The line is to be 40 miles long and will extend from Norwich to Hartford.

PLAINFIELD, CONN.—News comes from this city that the Lawton Mills Company is installing an electric lighting system in the village which it owns on Lawton Heights.

WASHINGTON, D. C.—Reports come from this city that Vice Consul Albro L. Burnell, of Barranquilla, Colombia, states that an electric light and power plant is to be established in Barranquilla during the present year.

WASHINGTON, D. C.—The Secretary of the Interior, Washington, D. C., has executed a contract with the Salt River Valley Water Users' Association providing for the construction by the latter of certain features of the Salt River irrigation project, Arizona, the works upon completion to be turned over to the United States as a portion of the project. The contract includes the construction of power plants of sufficient capacity to generate a total of 9700 hp.

WASHINGTON, D. C.—Bids will be received until Sept. 13 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Mare Island (Cal.) Navy Yard the following supplies, according to Schedule 2822: 7000 ft. of single conductor and 1000 ft. twin conductor lighting wire, 14,200 lb. sheet copper, 13,000 lb. galvanized sheet steel; also same place until Sept. 20 for furnishing at the Puget Sound (Wash.) Navy Yard 600 lb. roller brass, 3200 sq. ft. asbestos felting, 2000 lb. asbestos plaster for pipe covering, 20,000 fire brick, according to Schedule 2841.

PENSACOLA, FLA.—It is stated that the Pensacola Electric Company, which furnishes energy for the city lighting, has practically completed the installation of new machinery in its plant. The heavy engines formerly in use have been replaced by 500-kw steam turbines, and the most modern generators, transformers and pumps substituted for the old machinery. Press reports state that the company has just been awarded a contract by the Government to furnish energy for Fort Barrancas.

KEY WEST, FLA.—It is stated that the City of Key West is considering the installation of an electric light plant. For particulars address the Mayor.

ALTO, GA.—Bids will be received until Sept 30 by the executive committee of the State Tuberculosis Sanatorium, 708 Gould Building, Atlanta, Ga. (W. G. Raoul, chairman), for work at the State Sanatorium, including wiring main buildings and four shacks now under construction for electric lighting and furnishing and installing fixtures for same; constructing brick power house with metal roof 18 ft. by 24 ft.; an oil or gasoline electric generating set to supply current for 200 16-cp lamps by night and during the day a pump for raising 80 gallons of water per minute to a height of 208 ft., horizontal distance 1350 ft., size of main 4 in.; also a motor-driven pump for said service. Bidder to give name of manufacturer and furnish plans for layout and installation. R. T. McDonald, Alto, superintendent of construction.

ATHENS, GA.—The Athens Railway & Electric Company, the recently organized corporation which took over the former street railway company, is pushing work on the dam and power house construction of the new plant at Barnett Shoals. When completed the plant will afford the City of Athens ample energy for lamps and street railways, and will also furnish electricity for a large cotton mill of half a million spindles.

CARIO, GA.—It is reported that the municipal electric light and water works at this city expects to double the equipment of its plant during the fall and early winter by the installation of new machinery. It is understood that contracts for the equipment have not as yet been placed.

IDAHO FALLS, IDAHO.—A reorganization of the Idaho Power & Transportation Company has been effected and J. W. Springer, of Denver, has been put in charge. A large amount of Denver capital has recently been invested in the company and it is understood that improvements and additions are to be made to the plant.

DECATUR, ILL.—The A. E. Staley Starch Manufacturing Company, which has recently awarded contracts amounting to about $75,000 to the Charles W. Gindele Company, of Chicago, for the erection of new factory buildings, will within a short time place orders for $25,000 of electrical machinery.

DECATUR, ILL.—It is the intention of the Central Union Telephone Company to expend in the neighborhood of $45,000 in extending and improving its system in this city. About 60,000 ft. of aerial cable will be strung, 5000 ft. of cable installed in underground conduits and a new multiple switchboard equipped for 600 additional telephones added to the company's exchange.

JACKSONVILLE, ILL.—Bids were opened on Aug. 30 by the Commissioners of the Meredosia Lake Drainage and Levee District, at the office of Charles W. Brown, Jacksonville, engineer for the delivery and installation at the pumping station in the district as follows: One simple condensing four-valve engine of 114 hp. one 72-in. horizontal tubular boiler 18 ft. in length, one single suction 24-in. volute pump with delivery of 15,000 gallons per minute, one surface condenser of 400 sq. ft. surface, necessary auxiliaries, etc. The contract was awarded to the Erie City Iron Works, of Chicago, Ill., for $10,000.

RUSHVILLE, ILL.—Bids were opened on Aug. 26 in the office of Judge H. V. Teel, secretary of the Crane Creek Drainage and Levee District, Rushville, Ill., for the delivery and installation at the pumping station of the district for the following equipment: One tandem compound condensing engine, 280 hp; a centrifugal pump; two 72 x 18 horizontal tubular boilers, surface condensers. The contract was awarded to the Arbuckle-Ryan Company, of Toledo, Ohio, for $18,000. C. W. Brown, of Jacksonville, is engineer for the district.

CAMBRIDGE CITY, IND.—It is announced that Paul H. White, of Indianapolis, Ind., has been appointed by the town trustees of Cambridge City as engineer to supervise the remodeling of the municipal electric light plant, for which purpose a bond issue, as previously reported, was recently voted upon by the citizens of that city. It is understood that plans and specifications for the proposed improvements will be prepared at once.

FORT WAYNE, IND.—It is reported that the Indiana Lighting Company, Lafayette, Ind., is considering the construction of a cold storage plant and boiler-room on East Superior Street, Fort Wayne.

FORT WAYNE, IND.—Application has been made to the commissioners by the Fort Wayne & Toledo Electric Railway Company for a new franchise to construct an electric railway through Allen County. The proposed line will be 42 miles long, and will connect Fort Wayne and Maysville, Ind., and Hicksville, Bryan and Toledo. R. T. Bastress, Harlan, is general manager of the company.

MARION, IND.—It is announced that the City Council has purchased a site for a municipal street lighting plant, and that steps will be taker at once to construct same.

SOUTH WHITLEY, IND.—It is reported that the South Whitley Electric Company is to enlarge its lighting plant, plans for the work having been perfected at a special meeting of the town board recently.

STROH, IND.—A new telephone line from this city to Brushy Prairie is being constructed by the Farmers' Telephone Company.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company has closed a contract with the Iowa City Electric Railway Company to furnish it with power for the operation of its cars, it being the intention of the latter company to install service about the first of November.

ELDORA, IA.—The Park Dam Company has been organized by E. H. Lundy, who recently applied for a franchise to install an electric light plant at this city, and George F. Wood, both of Eldora. In return for the franchise the new company proposes to construct a dam across the Iowa River and install a power plant which will furnish a day and night electrical service. It is stated that a sufficient number of signatures have been obtained to insure the success of the project and that a special election has been called by the Mayor for the purpose of voting on the franchise.

FORT DODGE, IA.—It is reported that the line between Fort Dodge Junction and Rockwell City, formerly known as the Newton & Northwestern line, is to be electrified at an early date by the Fort Dodge, Des Moines & Southern Railroad Company.

KEOKUK, IA.—Press reports state that within a short time the Keokuk & Hamilton Water Power Company, which is constructing a $14,500,000 dam on the Mississippi River, between Keokuk, Ia., and Hamilton, Ill., will be succeeded by the Mississippi River Power Company. The latter company is to be incorporated under the laws of Maine, and will be the parent organization. The Mississippi River Power Distribution Company, which was organized a year ago under the laws of New Jersey, and which is an auxiliary company, will transmit to St. Louis 60,000 hp of the 200,000 which is to be developed at the dam and turn it over to the several public utilities with which contracts have already been entered into.

MONTICELLO, IA.—Press reports state that the Monticello Electric Light Company has purchased property on both sides of the Maquoketa River at Pictured Rocks, the site to be used for the location of a dam and power house to supply energy for its electric light plant.

ELDORADO, KAN.—It is understood that negotiations have been entered into between J. H. Glazier, representing a syndicate of Kansas City capitalists, and the Commercial Club, of Eldorado, looking toward the location of an electric power plant along the Walnut River which will furnish electricity to the neighboring towns.

KANSAS CITY, KAN.—In his report to the Mayor and Commissioners, Emil Barth, special engineer, who was recently instructed to ascertain the value of the equipment of the Consolidated Electric Light & Power Company, with the exception of the Riverview power plant, also the cost of improvements to make a complete municipal lighting plant, states that it would cost Kansas City $350,000 to establish a municipal light and power plant to be operated in connection with the municipal water works. This sum covers the purchase price of the outside equipment, poles, lines and service of the old light company, and the cost of putting up a new power house.

HARLAN, KY.—Plans are being prepared for the construction of an electric light plant in Harlan, to cost about $7,500. M. R. Howard, of Harlan, Ky., is engineer in charge.

FARMINGTON, MAINE.—It is stated that work on the Franklin Power Company's new generating plant at North Anson is nearing completion and that the company will soon be able to furnish electricity from the Carrabasset River, 16 miles distant, to Farmington. The work represents an expenditure of approximately $100,000.

BALTIMORE, MD.—The board of awards on Aug. 31 awarded the contract for the new heating, lighting and water plant at Bayview as follows: The power house to F. Decker & Son, for $24,900; engines and electrical apparatus to the Kingbury-Samuel Company, for $23,269; the boilers for $70,250 and the water supply machinery for $20,368 to Thomas C. Basshor & Company.

FREDERICK, MD.—It is the intention of the Frederick Railroad Company, in addition to electrifying the Thurmont division running from Frederick to Thurmont, formerly called the Washington, Frederick & Gettysburg road, to build and equip a new power house at an estimated cost of $200,000.

BOSTON, MASS.—Press reports state that Chairman Edward M. Gallagher of the board of trustees of the city's pauper institutions has petitioned Mayor Fitzgerald for an additional appropriation of $2,500 for installing a turbine engine in the new institutions boat, the George A. Hibbard, now being built at Lawley's ship yards.

BROCKTON, MASS.—One hundred new street lamps have been petitioned for by the city of Brockton and it is understood that the street lighting committee is considering the advisability of keeping the incandescent street lamps burning all night, instead of until 1 o'clock in the morning, as is the present custom.

FITCHBURG, MASS.—On account of the scarcity of water at the large dam across the Connecticut River at Vernon, Vt., the Fitchburg Gas & Electric Light Company is supplying energy to the Connecticut River Transmission Company. The Fitchburg company is transmitting about 1500 hp a day to the power company.

NEWBURYPORT, MASS.—As a matter of experiment, the City of Newburyport will try an all-night lighting service for three months instead of its present service, the rate secured being $90 per annum per lamp. This action was decided upon at a recent meeting of the lighting committee, with the idea of recommending to the City Council the entering into of a contract for five years on the same basis.

NORTH ADAMS, MASS.—It is stated that Weber Brothers, of this city, are installing an electric plant for lighting purposes at their factory.

NORTHFIELD, MASS.—At a special meeting held in this city recently it was voted to have the lighting committee contract with the Greenfield Electric Light & Power Company for street lamps for a term of five years at a price not to exceed $1,200 per year.

SALEM, MASS.—Work has been commenced by the Salem Electric Lighting Company in this city on the installation of its underground conduit system, which, it is estimated, will represent an expenditure of approximately $50,000. The company's plan contemplates adding each year a stated amount of conduits until all of the wires of its system are underground.

WALTHAM, MASS.—It is reported that work is soon to be commenced by the Edison Electric Illuminating Company on the installation of three-phase, alternating-current motors in the business houses and factories throughout the city where direct-current motors are now in use.

DEARBORN, MICH.—Plans are being prepared by Donaldson & Meier, architects, Penobscot Building, Detroit, for a new power house and equipment for St. Joseph's Retreat, Dearborn. Two new water-tube boilers, engine and a 50-kw generator will be required.

PONTIAC, MICH.—Plans are being matured for the organization and establishment of a new telephone company in Pontiac, an ordinance having been introduced into the City Council by the Pontiac Telephone Company providing for a franchise to operate a public telephone system in the city. The promoters of the enterprise are: M. A. Rittenhouse, of Detroit; W. A. Brewster, of Pontiac, and J. E. Brondige, who is attorney for the company. It is the intention of the new concern to install a strictly up-to-date system.

MANKATO, MINN.—Work is soon to be commenced by the Consumers Power Company on a new substation in this city. It will be located on West Vine Street, near the company's plant, and all the switchboard appliances for the high tension wire which is to be brought in from Rapidam will run into the building, the power being stepped down to accommodate the service of the city. Later on, wires from this station will be run to Waseca, Janesville and Faribault, eventually connecting with the Cannon Falls line.

MELROSE, MINN.—A modern telephone system from this city to Barnesville is being installed by the Great Northern Railway Company. The new line is to be utilized by the company for train dispatching.

MINNEAPOLIS, MINN.—The Electric Short Line Railroad Company, of Minneapolis, has applied to the Town Council of Cosmos, Minn., for permission to construct an electric railway line in that city. A similar franchise has been asked by the company in Cedar Mills. Frank E. Reed, Glencoe, is secretary.

ROCHESTER, MINN.—It is stated that plans have been prepared by E. D. Jackson, engineer, St. Paul, for putting the electric light wires underground and installing a new lighting system in Rochester at an estimated cost of $2,000 a block.

LA GRANGE, MO.—Press reports state that the city contemplates the installation of an incandescent street lighting system. For particulars address the Mayor.

ST. LOUIS, MO.—The Springfield & Central Illinois Traction Company states that as soon as preliminary work is finished it will commence construction on its proposed interurban railway to connect Springfield, Paronee, Morrisonville, Hillsboro, Coffern, Greenville, Carlyle, Centralia, Flora, Mount Carmel, Edwardsville and East St. Louis. It will also furnish energy for lighting its headquarters, Security Building, St. Louis, Mo. Isaac A. Smith, Security Building, is one of the promoters of the enterprise.

BIG FORK, MONT.—It is understood that Cramer Brothers, of this city, are planning to operate their saw mill at Lakeshore with electricity.

WHITEFISH, MONT.—Press reports state that the Whitefish-Polson Electric Railway Company has secured the right-of-way for enough of its proposed line to justify it in going ahead with construction work, and it is believed that an initial start on the first section of its line, either from Whitefish to Kalispell, or from Kalispell to Polson, will be made at an early date.

BAYARD, NEB.—The installation of an electric light and water works system is being considered by the City of Bayard.

MADISON, N. J.—The Common Council of Madison has been petitioned by the Morris County Traction Company, of Morristown, for permission to construct an electric railway to connect Madison with Pennsylvania, across northern New Jersey, via Chatham and Morristown. The company has already been granted a franchise in Chatham.

NEWARK, N. J.—The Hudson & Middlesex Telephone & Telegraph Company, whose application for permission to install a conduit system along Frelinghuysen Avenue was recently noted, has already received the board of works approval of the map which it filed of the proposed work. William J. Lansley is president of the company, and Edward Kenny, of East Newark, counsel.

TRENTON, N. J.—It is stated that David Pepper, Jr., of Philadelphia,

Pa., owner of the Trenton Water Power Company, if the proper legislation can be secured, contemplates the construction of a power plant in Trenton of sufficient capacity to furnish electrical energy for the operation of all the factories in the city.

GENEVA, N. Y.—At a recent special meeting in this city, the Board of Public Works declined to make any arrangements with the Geneva-Seneca Electric Company, which would permit that company to make further improvements to its plant on the lake front. The plant of the company is located on what is known as Lakeside Park lands, which the city claims to own under a grant from the State. The position of the city having been sustained in the courts, the Geneva-Seneca company has been forced to abandon the proposed addition to its plant, and as a result contracts for the contemplated improvements, representing an expenditure of about $40,000, have been canceled.

HORNELL, N. Y.—The Hornell Electric Company has been authorized to issue 120 shares of its common stock of the total par value of $12,000, the proceeds to be used for the purchase of additional apparatus and the payment of indebtedness incurred in the improvement of its plant.

RIVERHEAD, N. Y.—The most modern electrical equipment is being installed by the Riverhead Electric Light Company in its power station, it being the intention of the owners to install an entire new system in place of the one now in use. The voltage is to be increased from 1,100 to 2,300, and the frequency of the alternating current will be changed from 125 to 60 cycles. This change, in addition to giving more power and greater efficiency to lamps, will permit motors to be used by Riverhead business people, a utility which could not be enjoyed with the old plant. The company also has a franchise to light Westhampton Beach, and work on a transmission line to this place is now being rushed.

ASHEVILLE, N. C.—Owing to the excessive rise in the French Broad river at this place, the plant of the Asheville Electric Company is submerged and out of commission, the city is without car service, and all of the manufacturing plants using electric power are shut down.

ASHEVILLE, N. C.—The Tri-County Public Service Company, recently incorporated, has been organized with R. S. Howland, president; William Farr, vice-president and general manager, and Charles G. Lee, secretary and treasurer. The company proposes to furnish electrical service in the rural districts about Asheville, and also operate rural telephone exchanges.

CONCORD, N. C.—The Concord Telephone Company has recently completed the erection of a telephone line to Greensboro, a distance of 70 miles, and is contemplating the erection of another line to Statesville, about 45 miles in length.

CONCORD, N. C.—Work is progressing on the erection of the transmission line from Concord to the Bala Cotton Mills on Coddle Creek. It is proposed to change the motive power of the mills from steam to electricity. Power for operating the mills will be supplied by the Southern Power Company, of Charlotte, N. C. It is expected to have the line completed by Sept. 15.

CHARLOTTE, N. C.—Application has been made to the Board of Aldermen of Charlotte by the Piedmont Traction Company, of Gastonia, N. C., for a franchise to construct an electric railway system in Charlotte. The proposed line will be about 13 miles in length, and will connect Mount Holly, Charlotte and Gastonia. T. C. Lee is the engineer in charge.

CHARLOTTE, N. C.—The Piedmont Traction Company has been granted a 60-year franchise to operate a street railway in Charlotte. The company is constructing an interurban electric railway from Anderson, S. C., to Greenville, S. C., thence northward into North Carolina via Charlotte, Salisbury, and Greensboro to Durham. Arrangements are also being made by the company to build a road from Gastonia to Mt. Holly, N. C.

RUTHERFORDTON, N. C.—It is reported that the purchase of machinery for an electric generating and pumping station, for which a bond issue was recently voted upon in this city, will shortly be authorized.

WADESBORO, N. C.—It is reported that arrangements have been made whereby the development of electric power at Blewitt's Falls, near this city, will be completed. A mortgage has been filed by the committee of the Rockingham Power Company to the Old Colony Trust Company, of New York, N. Y., which will place additional funds at the disposal of the company for completion of the work. It is estimated that about $1,500,000 will be required to complete the hydroelectric development at Blewitt's Falls. Nearly $2,000,000 was spent prior to the legal entanglements of the concern.

BISMARCK, N. D.—Reports from this city state that several hundred acres of land at the site of the old post office village of Hancock, on the banks of the Missouri River, a few miles north of Washburn, have been purchased by a syndicate of capitalists for the purpose of establishing an industrial center. It is proposed to construct power plants which will supply electrical energy to the towns in the Missouri and James River Valleys, and possibly as far as the Red River Valley. The promoters of the new town, which is to be called Energy, have already made surveys and outlined their plans.

ENERGY, P. O. UNDERWOOD, N. D.—We are informed that the North Dakota Heat & Power Company has engaged J. S. Webster, Globe Building, Minneapolis, Minn., to take charge of the construction of its proposed power plant. The cost of the proposed work is estimated at about $1,000,000. T. L. Stanley is secretary of the company.

AKRON, OHIO.—An ordinance enabling the directors of public service to expend $27,000 to procure a lighting plant for the city has been presented to the City Council.

COLUMBUS, OHIO.—Councilmen Sherman, Harper and Ross, the committee appointed to ascertain the cost of equipping the municipal electric light plant for commercial service, have reported the decision to ask Herman Gamper, superintendent of the city light plant, for data concerning the cost of the necessary equipment. When this is obtained the committee will report back an ordinance to increase the plant's equipment and to submit to a vote the question of issuing bonds to defray the cost. It has been estimated that $300,000 will be required.

JACKSON, OHIO.—Sealed bids will be received by the Board of Trustees of Public Affairs, Jackson, Ohio, until Sept. 29 for furnishing materials and construction of additions to the municipal electric light plant as follows: Two 125-hp and one 100-hp single valve, automatic engines; one 400-hp open type feed water heater and purifier; one 7½-in. x 5-in. x 6-in. standard duplex boiler feed pump; one 8-in. recording steam gage; two 75-kw, 2300-volt, 60-cycle, three-phase, revolving field, belt-driven generators, with direct-connected exciters; one direct-current generator, capable of carrying 150 4-amp, direct-current, series luminous arc lamps; one 10-amp ammeter, mounted on bracket for machine panel board; two 2300-volt, three-phase, 60-cycle generators, exciter and feed switchboard panels, to be built of blue Vermont marble; 100 direct-current General Electric series luminous arc lamps or equal quality; 100 arc lamps, absolute cut-outs and lamp hangers; 30 4-amp, 250-watt, series Mazda lamps; 30 center span, series incandescent fixtures; one 110-volt, 60-cycle, alternating-current curve-drawing voltmeter, to be mounted on bracket and pipe supports of switchboard panel. Plans and specifications are on file at the office of the board, copies of which will be supplied on application to the secretary of the board. William Olendorf is president. The Board of Trustees of Public Affairs will also receive bids for the following machinery now in the plant, or exchange in connection with bids for new machinery, etc.: one Thomson-Houston dynamo; one No. 8 Wood, arc 6.8-amp, series constant potential dynamo; one 75-kw, single-phase, 133-cycle, 1100-volt, Warren alternator, with switchboard and instruments complete; two 12 x 13, center-crank, Ball engines; 36 A.-B., 6.8-amp, series arc lamps; 35 Thomson-Houston, 9.6-amp, open arc lamps; 8 Warner, 9.6-amp enclosed arc lamps.

MOUNT VERNON, OHIO.—Advices have been received from the Mount Vernon Railway & Light Company that it expects to place contracts within the next two weeks for motor generators, pumps, piping, heater, etc., for its new power house, the contract for turbines of 800 kw rating having been placed.

NEW CONCORD, OHIO.—The installation of the machinery for the new electric light plant in this city has been practically completed. It is the intention of the company to wire the college buildings in the city for electricity, as well as many of the business houses.

SANDUSKY, OHIO.—The only proposal submitted to John Bing, director of public works, for lighting the streets, public parks and highways of Sandusky for a term of 10 years, for which bids were recently advertised, was that of the Sandusky Gas & Electric Company, which has the contract to furnish the street lighting until Jan. 1, 1912. Three bids were presented, two of which were for the street arc lamps. Under the specifications as prepared by the city the company agrees to maintain arc lamps at $73 each per year. Under the specifications on which this bid is based the present poles would have to be reset and the wiring system considerably altered. The present cost per lamp to the city is $77.50. The Gas & Electric company's other bid was on an agreement which they submitted, under which they agree to furnish service at $66 a lamp per year, providing they are allowed to do so without further changes to the pole and wire system. In case the city agrees to accept this proposition, the company will also agree to furnish the street lighting during 1911 at the $66 per lamp rate, even though its $77.50 rate contract does not expire until 1912. A third bid was upon the alternate lighting plan for the business district bounded by the north side of Water Street, west side of Jackson Street, south side of Washington Park and east side of Wayne Street, the company agreeing to erect the posts and install the incandescent lamps as called for by the specifications for $20 a post year. It is possible that the Board of Control and the City Council may take under consideration the establishment of a municipal lighting plant, should the bids submitted be regarded as excessive.

BARTLESVILLE, OKLA.—H. Askin, formerly superintendent of the Atchison Railway, Light & Power Company of Atchison, Kan., has been appointed general manager of the Bartlesville Interurban Railway Company, instead of J. Atkin, as reported in the issue of Aug. 25.

HELENA, OKLA.—It is reported that an election is to be held at this city for the purpose of voting on a bond issue, the proceeds of which are to be used for the installation of an electric light plant.

MUSKOGEE, OKLA.—At a public meeting recently called by the Commercial Club, of this city, of which Mr. Paulding is president, $100,000 was subscribed toward the construction of an $800,000 hydroelectric plant on the Grand River.

SAPULPA, OKLA.—Press reports state that the Sapulpa Electric Company has been absorbed by H. M. Byllesby & Company, of Chicago, and that the new owners contemplate the expenditure of $100,000 in improvements and extensions to the plant. Harry B. Wales, Grand Rapids, Mich., will be manager of the company, with offices at Sapulpa.

COQUILLE, ORE.—It is reported that the plant of the Coquille River Electric Company, of this city, recently destroyed by fire, is to be rebuilt.

and that the equipment of the plant is to be considerably increased, as Myrtle Point, Norway and other communities are now included in the company's system. The former equipment consisted of a General Electric generator driven by an Atlas engine.

GREENHORN, ORE.—Press reports state that the owners of the Ben Harrison mine at Greenhorn, of which Mr. A. White, president of the locomotive works at Lima, Ohio, is the principal stockholder, are making arrangements with F. A. Harmon, manager of the Eastern Oregon Light & Power Company, Baker City, Ore., for the installation of electric power at the mine.

MADRAS, ORE.—It is stated that there is a prospect of the City of Madras securing a public water system and electric light plant, as the Newport Engineering Company of Portland is interested in the proposition, and negotiations for securing a franchise for such a plant are said to be under way.

UNION, ORE.—This city, it is stated, will vote Sept. 26 on a bond issue of $71,000, the proceeds to be used for installing an electric light plant.

PANAMA.—Bids will be received until Sept. 20 by the Isthmian Canal Commission at the office of Capt. F. C. Boggs, Corps of Engineers, U. S. A., Washington, D. C., for suction dredge ladder, steel castings, steel discharge pipe, electric motors, punches and dies, electric cable, etc., according to circular 603.

WOODVILLE, PA.—Bids will be received until Sept. 15 by R. J. Cunningham, county comptroller, Pittsburgh, for installing feeder system for electric lighting of buildings at the Allegheny County Home, Woodville. Audred McMaster, Curry Building, Pittsburgh, is architect.

DILLON, S. C.—The City Council will soon vote on a $15,000 bond issue for an electric light plant.

GREENWOOD, S. C.—It is stated that the Panola Cotton Mills, recently incorporated, expects to employ electrical motors in the operation of its new plant, energy being obtained over the Greenwood transmission lines of the Southern Power Company, of Charlotte, N. C., which are to be extended to that city.

CROSS PLAINS, TEX.—It is stated that the Cross Plains Townsite Company, recently incorporated with a capital stock of $10,000, will, in connection with the proposed development of 300 acres for town lots, construct an electric light and ice plant. The construction of a water works system and cotton oil mill is also being considered. The officers of the company are: C. H. Sharman, president; H. J. Cureton, vice-president; S. F. Bond, secretary and treasurer.

FORT WORTH, TEX.—Current reports indicate that it is the intention of the Fort Worth Telephone Company to expend $200,000 in improving its system in and about this city.

FORT WORTH, TEX.—The property of the Fort Worth Light & Power Company has been acquired by J. R. Nutt, of the Citizens' Saving & Trust Company, Cleveland, Ohio. It is stated that the site for a proposed new power plant has been secured, and that engineers will at once prepare plans for its construction. Engineers are also at work on plans for the installation of an underground conduit system, it being the new owner's purpose to place all wires within the fire district in the business portion of the city underground.

FRANKLIN, TEX.—Extensive improvements in its local telephone system are planned by the Franklin Telephone Company.

TEMPLE, TEX.—The Temple Commercial Club is reported to be interested in a project to construct a telephone line parallel with the Temple Northwestern Railroad, and it is understood that the necessary funds to put the plan into operation will be secured at an early date.

TERRELL, TEX.—It is reported that the City of Terrell has voted favorably on a $10,000 bond issue, the proceeds to be used for improving the water works and electric light plant.

TYLER, TEX.—Advices have been received to the effect that the Cotton Belt Shops of this city will install a complete electrical equipment within 60 days.

TYLER, TEX.—About $10,000 is being expended by the Southwestern Telephone & Telegraph Company in improving its system at Tyler. Plans are also being considered by the company for rebuilding its lines in Calvert.

LOGAN, UTAH.—Application has been made by the Logan Rapid Transit Company to the county court for a franchise to construct an electric railway in Logan City. The proposed line will extend from the county boundary in Wellsville Canyon via Wellsville, Hyrum, Millville, Providence and River Heights to Logan, thence to Greenville, Hyde Park, Smithfield and Richmond to the state northern boundary. David Eccles is president of the company.

LOGAN, UTAH.—It is stated that $6,000 has been offered for the Logan electric light plant by the Bullock Public Service Company, of Omaha, a proposition having been made at the same time by Mr. Bullock to the business men of Logan to take $6,000 in electric light 5 per cent bonds, on the promise that stock would be issued to the extent of one-half the amount taken. An investigation of the proposition has been undertaken by the Commercial Club of the city.

RICHMOND, VA.—It is announced that the Richmond Power Corporation, recently incorporated to install a plant at Midlothian for the purpose of furnishing electrical energy to Richmond and Petersburg, has absorbed the James River Coal Company, and that application for a franchise to operate in Richmond is soon to be made. S. D. Crenshaw, of Richmond, is vice-president of the company, and Major Miles M. Martin, attorney.

LOON LAKE, WASH.—Press reports state that Gherke & Sons, of the Gherke Mill Company, are planning for the installation of a light and water system at Loon Lake.

TACOMA, WASH.—Press reports state that the City Council has passed an ordinance granting to the Northern Pacific Railway Company permission to erect and maintain poles and string wires for the transmission of electric power on Railroad Avenue, this city.

FAIRMONT, W. VA.—All of the new machinery and tools to be installed by the Fairmont Mining Machinery Company in the extensions it is making to its plant will have individual electric drive. Holbert & Speeden, Fairmont, are contractors.

ALBANY, WIS.—It is stated that the Albany Electric Light & Milling Company, of this city, is having plans prepared for a power plant, with hydraulic turbines connected to alternating-current generators by shafting rope drive.

BEAVER DAM, WIS.—It is the intention of the Beaver Dam Foundry Company, of this city, to install electric equipment in its foundry, energy for its operation being supplied from the mains of the Beaver Dam Light & Power Company.

CEDARSBURG, WIS.—It is the purpose of the Cedarsburg Box & Woodwork Manufacturing Company, recently organized, to operate the machinery in the new factory which it is to erect in this city with electric motors, the energy being secured from the municipal electric light plant.

CRANDON, WIS.—Advices have been received from Clyde Warnich, city clerk, that the contract for constructing an electric light plant at this city, bids for which were opened on Aug. 30, has been awarded to the Langstad Beyer Construction & Supply Company, for $12,500. A. H. Meyer, of Appleton, is engineer.

GRAND RAPIDS, WIS.—It is stated that a hydroelectric plant is to be constructed and equipped in the early spring at Radisson, Wis., by the John Arpin Lumber Company, of Grand Rapids, Wis.

MILWAUKEE, WIS.—Press reports state that the Milwaukee Separator Company, which now operates in leased quarters, is planning to build a factory of its own which will be equipped with electric motors.

CALGARY, ALTA., CAN.—It is stated that City Engineer Child has rendered a report on the proposed development of 3500 hp in the Elbow River, the estimated cost being placed at $800,000, while the cost per hp is figured at $25.

NELSON, B. C., CAN.—Permission has been granted to the Pacific Exploration Company to erect a large electric power plant on the Pend d'Oreille River, and plans for the proposed plant, which will have a rating of 25,000 hp and will be so constructed that the equipment may be doubled, will be forwarded for the consideration of the Lieutenant-Governor in Council. The promoters of the enterprise expect to furnish electrical energy to the Pend d'Oreille Valley, the Sheep Creek and Ymir districts, and to the Orient, Chewals and Metaline districts.

PRINCE RUPERT, B. C., CAN.—The following report has been submitted by City Engineer William Mahlon Davis, formerly of Berlin, Ont., on the installation of an electric plant for Prince Rupert. The total cost of the proposed plant is placed at $8,983, which includes the following items: Sixty-kw generator with exciter switchboards, $2,000; new poles, $417; engineering and erection, $1,000; 64,118 ft. of No. 4 x No. 6 wire, $2,088; poles and cross-arms transformers, etc., $1.478; engineering and erection, $2,000. Mr. Davis has also considered the installation of a steam plant at the foot of McBride Street of sufficient capacity to provide 5000 16-cp lamps for Section 1, and a proposal for a gas-producer plant to operate a 75-kw, alternating-current generator has been submitted. The cost of the latter plant for the generation of electricty is given as $11,840, to which would have to be added the cost of pole lines and distribution, $1,000, making a total of $21,000. This proposition would provide 3000 tungsten lamps. The report has been referred to the light committee.

BRANDON, MAN., CAN.—The City Council at a recent meeting declined to accept the proposition of the Brandon Electric Light Company to operate the city's pumping station by electricity, the objection to its acceptance being based on the fact that the figures named were excessive. The company offered to operate the station with 100 hp at an annual cost to the city of $7,000, and for all power required in excess of that amount, $70 per hp for 24-hour service. The question of the installation of a municipal plant is now being considered.

BRANTFORD, ONT., CAN.—The Grand Valley Railway Company, of Brantford, Ont., will place contracts during the next two weeks for building a substation at Paris, Ont., and for equipping an 8-mile, 40,000-volt, three-phase transmission line. It will also purchase two 300-kw generating sets. William P. Kellett is general manager.

NORTH TORONTO, ONT., CAN.—At a recent meeting of the water, fire and light committee the Toronto Electric Light Company, through the committee's engineer, presented to the city the following proposition: To purchase from the city the existing pole line on Yonge Street, giving to the city the privilege of running the fire alarm wires on the company's poles; to provide electricity for the arc lamps at present in use on Yonge Street at the same price the town is now paying, as well as to light the side streets; to supply electricity for lamps and motors at the same rate charged in Toronto pays, and should Toronto get any reduction the same rate to apply to North Toronto.

SARNIA, ONT., CAN.—Advices have been received from the Sarnia

Street Railway Company that it expects to purchase during the next few weeks a 350-kw to 500-kw generator. H. W. Mills, Sarnie, is general manager.

TORONTO, ONT., CAN.—The Canadian Power & Paper Company, with headquarters in Toronto, which has recently been incorporated for the manufacture of paper, proposes to develop electric power in connection with its plant. It is capitalized at $10,000,000, and the incorporators are: F. H. Phippen, Gerald Ruel, G. F. Macdonnell and others, all of Toronto.

WELLAND, ONT., CAN.—A franchise has been granted by the township of Crowland to C. J. Laughlin, Toronto, Ont., to construct an electric railway from Welland to Welland Junction.

PACHUCA, HIDALGO, MEXICO.—The Amalgamated Mining & Milling Company, of Pachuca, is reported to be interested in a hydroelectric project to be developed in connection with the 6½-mile tunnel which is being constructed in the Pachuca mining district. It is planned to construct a canal about 1400 ft. long from the mouth of the tunnel to a mountain gorge, where the large volume of drainage water will be given a fall of about 700 ft., affording the initial power for generating electrical energy.

New Industrial Companies.

THE AERIAL MANUFACTURING & SUPPLIES COMPANY, of New York, N. Y., has filed articles of incorporation and intends to manufacture aeroplanes, automobiles, hydroplanes, etc. It has an authorized capital stock of $50,000, and the incorporators are: S. Shethar, Great Neck; J. Loughran, Long Island City, and C. H. Stoll, New York, N. Y.

THE AMERICAN AEROPLANE MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000, and contemplates the manufacture and sale of aeroplanes, motors, etc. Those responsible for its formation are: E. E. Freed, S. J. Lebach, New York City, and P. J. Minck, Brooklyn, N. Y.

THE BAKER-SMITH MACHINE COMPANY, of San Diego, Cal., has filed articles of incorporation for the purpose of engaging in general engineering, manufacturing and electrical construction business. It is capitalized at $10,000, and its incorporators are: Robert Baker, Fred Baker, Perry Smith and others.

THE BLAKEMAN MANUFACTURING COMPANY, of Naugatuck, Conn., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing electric and gas lighting fixtures, also gas and electric light supplies. Those responsible for its formation are: Nils A. Olson, C. W. Thompson, Joseph Carlson, Victor Olson, Joseph Frick, Charles O. Sundvall and Frank Johnson.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of Dallas, Tex., has filed articles of incorporation and expects to do business in the state of Texas. It has an authorized capital stock of $16,000.

THE ELECTRICAL UTILITIES CORPORATION, of New York, N. Y., has been incorporated to do a general contracting business and electrical work of all kinds. It is capitalized at $10,000, and the incorporators are: Nathan Cohen, 27 West Twenty-seventh Street, New York, N. Y.; G. Cohen, 269 West 153d Street, New York, N. Y., and Norman S. Risenfeld, 141 Broadway, New York, N. Y.

GROVER & HELEKER, INC., of Syracuse, N. Y., have filed incorporation papers and propose to conduct an electrical engineering business. The new concern is capitalized at $20,000, and the incorporators are: Harry Grover, Syracuse, N. Y.; E. P. Heleker and Clarence E. Heleker, Onondaga, N. Y.

THE KERMONT INCANDESCENT LAMP COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $100,000. The incorporators are: F. M. Shive, S. E. Roberson, Harry W. Davis, all of Wilmington.

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, of New York, N. Y., whose purpose is to do electrical work of all kinds, act as electrical engineers and deal in dynamos, motors, etc., has filed articles of incorporation. It has an authorized capital stock of $10,000, and the incorporators are: Charles I. Taylor, Frank H. Parcells and Robert G. Redlefsen, all of 54 Wall Street, New York, N. Y.

THE STRAIGHT FILAMENT LAMP COMPANY, of New York, N. Y., has filed articles of incorporation and expects to deal in electric lamps, fixtures, etc., and do electrical work of all kinds. It is capitalized at $300,000, and the incorporators are: F. W. Greenfield, S. L. Jaffray, W. S. McCartney, all of New York City.

THE WILSON AUTOMOBILE COMPANY, of Troy, N. Y., capitalized at $10,000, has been incorporated to manufacture and deal in motors, engines, automobiles, accessories, etc. Those responsible for its formation are: John V. D. Wilson, Frank H. Deal, both of Troy, N. Y., and A. M. Powers, Cohoes, N. Y.

New Incorporations.

HAZEN, ARK.—The Hazen Power & Light Company, which proposes to furnish electrical energy for industrial purposes, making a specialty of rice mills and irrigating plants, has been organized with W. H. Fox, Nashville, Tenn., as president, and Harvey Jones, Hazen, as secretary. The company, which also expects to manufacture ice and supply light to the town of Hazen and the surrounding country, expects to commence work upon the construction of its plant at once.

NASHVILLE, ILL.—The Lafferty Telephone Company has been organized for the purpose of building an independent telephone system throughout the county. C. W. Lafferty is interested in the project.

WABASH, IND.—The Lagro-Andrews Telephone Company has filed articles of incorporation with a capital stock of $26,000. The incorporators are: William C. Taylor and Daniel O. Taylor.

PORTLAND, MAINE.—The Mississippi River Power Company has been chartered with a capital stock of $500,000 by H. M. Mitchell, H. C. Wilber, Arthur Chapman and George G. Day, all of Portland, Maine.

PORTLAND, MAINE.—The Sewage & Garbage Power Company has been organized with a capital stock of $1,000,000. The company proposes to install sewage and garbage plants to be utilized for generating power and using same. Charles E. Allen, of Abington, Mass., is president and treasurer.

MINNEAPOLIS, MINN.—The Co-Operative Electric Company has been chartered with a capital stock of $25,000 by J. T. Kutchiners, H. E. Nye and J. C. Armbuster, of Minneapolis, Minn.

ROBBIN, MINN.—The Robbin Rural Telephone Company has been chartered with a capital stock of $3,500. Louis J. John is president of the company.

TIPTONVILLE, MO.—Articles of incorporation have been filed for the Tiptonville Light & Power Company with a capital stock of $7,500 by A. E. Markham, R. S. Wright, J. P. Alexander, P. J. Caldwell and J. T. Burnett.

HOBOKEN, N. J.—The Commercial Telephone & Telegraph Company has been organized with a capital stock of $15,000. The incorporators are: G. A. Berger, G. B. Fields and F. H. Schaef.

BELMONT, N. Y.—The Allegany County Telephone Company has filed articles of incorporation with a capital stock of $200,000. The incorporators are: C. Ricker, of Belmont, N. Y.; H. F. Stevens and B. H. Shepard, of Syracuse, N. Y.

NORWICH, N. Y.—Articles of incorporation have been filed by the Marquis Telephone & Telegraph Company. It has an authorized capital stock of $100,000. The incorporators are: J. B. Marquis, J. J. Ray and J. O. H. Reed, Norwich, N. Y.

OTSEGO, N. Y.—The Otsego & Delaware Telephone Company has been incorporated with a capital stock of $750,000 by H. F. Stevens, of Syracuse, N. Y.; J. E. Fraser, of Auburn, N. Y.; H. P. McDonough, of Newark, N. Y.; F. Sponable, Fort Plain, N. Y., and C. W. Hitchcock.

WATKINS, N. Y.—The Wedgewood Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $1,000. The incorporators are: O. F. Corwin, W. T. Wakeman, Ray W. Corwin, all of Watkins, N. Y.

COLERIDGE, N. C.—Articles of incorporation have been filed by the Coleridge Telephone Company. It has an authorized capital stock of $10,000. D. H. Lambert and others are among the stockholders.

HARRISBURG, N. C.—Articles of incorporation have been filed for the Harrisburg Telephone Company with a capital stock of $10,000 by S. A. Grier and others.

THOMASVILLE, N. C.—The Lee Telephone Company has filed articles of incorporation with a capital stock of $10,000 to construct and operate a telephone system between Thomasville and Denton, N. C. The incorporators are: J. W. Lee, of Thomasville, No. 4; I. E. Lee, of Light, N. C., and others.

WOODLAND, N. C.—The Roanoke-Chowan Telephone Company, with headquarters at Woodland, has been incorporated with a capital stock of $50,000. S. A. Brier being one of the incorporators.

DUNCAN, OKLA.—The Duncan Electric Light & Ice Company, of this city, has filed articles of incorporation. It has an authorized capital stock of $75,000, and the following directors have been elected: E. S. Bessey, M. M. Dunaway, of Oklahoma City, and John C. Keys, of Cleveland.

GUTHRIE, OKLA.—A charter has been granted to the Oklahoma Public Service & Interurban Lines, a corporation which proposes to construct and maintain steam and electric railways in Oklahoma and Kansas. The cost of the proposed system is estimated at $6,000,000. The company is capitalized at $100,000 and the directors are: L. L. Brullard, A. C. Lampke, George Washington Tucker, Jr., and Harry C. Lytle, of New York, N. Y.

PITTSTON, PA—The Jenkins Electric Company has been incorporated by R. M. Hughes, J. H. Glennon and K. J. Ross, all of West Pittston, Pa. The company is capitalized at $5,000 and proposes to supply electricity for lamps and motors.

GREER, S. C.—The Greer Light & Power Company has been chartered with a capital stock of $25,000. The officers of the company are: Z. V. Taylor, president, and E. C. Marshall, secretary and treasurer.

McCONNELLSVILLE, S. C.—The McConnellsville Telephone Company has been chartered with a capital stock of $5,000 by J. F. Ashe, J. O. More and J. M. Williams. The company proposes to erect a telephone line from McConnellsville to Chester, a distance of 12 miles.

BEACH, S. D.—The Beach Electric Company has been incorporated with a capital stock of $50,000 by J. G. Robertson, Alexander R. Robertson, both of St. Paul, Minn., and George S. Chrysler, of Beach, N. D.

MADISONVILLE, TENN.—The Monroe County Tellico Power Company has been chartered with a capital stock of $10,000 by Morrison B. Morrill, R. C. Kefauer, D. E. Lourey and others.

NASHVILLE, TENN.—Application for a charter in Tennessee has been made by the Tennessee Rapid Transit Company, which contemplates the construction of 110 miles of interurban electric railway to connect Nashville, Lewisburg, Springfield and Clarksville, Tenn., with an extension to Adairville, Ky. The company has an authorized capital stock of $3,500,000, and the incorporators are: Robert L. Burch, Richard T. Wilson, Joe Frank, John M. Gray and R. M. Wilson, all of Nashville, and J. Parks, Franklin.

SPARTA, TENN.—The Home Telephone Company of White County has been organized, and will at once commence the construction of a telephone system in Sparta. The following officers have been elected: S. Johnson, president; C. W. Roberts, vice-president; J. L. James, secretary and treasurer.

Personal.

MR. D. P. ROBERTS, electrical engineer at London, Ont., Canada, has been appointed electrical expert and inspector for the British Columbia Government.

MR. H. ASKIN, formerly superintendent of the Atchison Railway & Light Company, has been appointed general manager of Bartlesville, Okla., Interurban Railway Company.

MR. DAVID W. PYE has been elected president and a director of the United States Light & Heating Company, the general office of which is at 30 Church Street, New York.

MR. J. AUERBACH, president of the Electrical Accessories Company, 1246 Broadway, New York, returned from his annual trip to Europe last week. Mr. Auerbach says that he found the electrical business in Germany very much improved.

MR. T. J. BALLARD, for some years electrical engineer of the municipal central station of Sheffield, England, is on a visit to this country, where he will probably take up a residence. Mr. Ballard was for several years engaged in professional work in the United States prior to his appointment at Sheffield.

MR. C. G. Y. KING, formerly mechanical engineer of the Chicago Edison Company, predecessor of the Commonwealth Edison Company of Chicago, is now again connected with the company as construction engineer of the great Northwest Station on the north branch of the Chicago River, work on which has just been begun.

MR. A. BEMENT, consulting engineer, of Chicago, was married in Berkeley, Cal., on Aug. 23 to Miss Eva Henderson, of Berkeley. During the honeymoon tour the newly married pair figured in a coaching accident on Mount Tamalpais, near San Francisco, due to runaway horses, and their friends in Chicago, who had read somewhat exaggerated accounts in the daily papers, were glad to be assured by private advices from Mr. Bement to the effect that the accident was a slight one, with no serious consequences.

MR. THEODORE STEBBINS, of Herrick & Stebbins, New York, has made a contract with the directors of the Springfield Light, Heat & Power Company, Springfield Ohio, to manage its business. Mr. Weare Parsons has been appointed general manager of the company which will soon complete a new 6000 hp. steam turbine station. Mr. Stebbins has also accepted the management of the railway and lighting properties at Mt. Vernon, Ohio, and A. J. Darrah has been appointed superintendent at that place. These contracts do not interfere with the firm of Herrick & Stebbins.

MR. FREDERICK F. GARDNER, general manager of the Shore Electric Company, Red Bank, N. J., has been missing since August 23. Mr. Gardner's family are very much alarmed about his disappearance, and the police authorities of Red Bank have sent out a general notice asking for any information as to his whereabouts. Mr. Gardner has been identified with the electrical business for 25 years, and formerly resided at Englewood, N. J., and was connected with the Public Service Corporation. He is about forty-five years of age, and leaves a wife and one child. No explanation of his absence can be furnished either by his family or by the officials of the company with which he was connected.

ETIENNE FODOR DE VARKONY.—On the occasion of the eightieth birthday of Emperor Francis Joseph of Austria and Hungary (Aug. 18), a special honor was conferred upon Mr. Etienne de Fodor, general manager of the Budapest General Electric Company. The official Gazette of Hungary announced on that date that the King had confirmed and certified the noble descent of the de Fodor family, which action restores to the family name its former addition of "Varkony." The original papers and family documents were lost during the wars and political disturbances to which Europe was subjected in past centuries, and in recognition of the scientific services that de Fodor has rendered the Emperor was pleased to reconfirm by a royal decree the family pedigree.

MR. JAMES R. DEANE, a well-known electrical man in Chicago, has established the firm of J. R. Deane & Company, with office at 46 Van Buren Street, Chicago, to deal in electrical specialties. The new organization will represent the Peerless Electric Company, of Warren, Ohio, manufacturer of dynamos and motors, and the Massachusetts Electric Manufacturing Company, of West Lynn, Mass., which makes magnet wire. Mr. Deane has had an extensive practical experience in the electrical business. Beginning in the Chicago office of the General Electric Company, he was next employed in the shops of the Gregory Electric Company. Following that he formed a connection with the Northwestern Electric Company, of which he became secretary and treasurer. Later he was for some time sales manager of the Guarantee Electric Company, a position which he resigned a short time ago. Combining excellent business ability with pleasing social qualities and a cheerful outlook on the world, Mr. Deane is a man who has made friends at each step in his career—friends who will be pleased to learn he has engaged in business for himself.

Trade Publications.

McCASLIN CONVEYORS.—The Mead-Morrison Manufacturing Company, Cambridgeport, Mass., has made the McCaslin overlapping gravity bucket conveyor the subject of a handsome cloth-bound volume which is highly creditable to all concerned in the design and execution of the book. Beyond a few words of introduction, the contents consist of illustrations of recent installations of conveyors, each accompanied with a concise sentence or two pointing out the particular feature of interest to be observed. There are not far from 200 of these illustrations, which are excellently engraved from photographs, and as the dimensions of the page—8½ in. by 11½ in.—permit the cuts to be of large size, details are well brought out. One looking through these pages can, with the aid of the short notes under the engravings, form perhaps a better idea of the operation of the conveyor and an appreciation of its flexibility of application than if a considerable portion of the contents consisted of the usal descriptive text. The binding accords with the excellent paper, engraving and presswork of the book, the cloth and end papers being especially pleasing in effect.

BUSINESS NOTES.

THE JUDD OSCILLATING CLEANER COMPANY, of Chicago, which manufactures an electric washing and wringing machine, has changed its name to Domestic Equipment Company.

THE R. THOMAS & SONS COMPANY announces the opening of an office at 1255 Old Colony Building, Chicago, Ill., in charge of Mr. R. W. Harms, who has been with the company at New York for over five years.

ELMER P. MORRIS COMPANY, manufacturers of posts, poles and specialties for out-door lighting, has largely increased its office room at No. 90 West Street. The main building of its new factory at Elizabethtown, Pa., has been completed and ground has been broken for the remainder of the plant. The company reports that it has been the largest year it has ever had.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 30, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

968,520. ELECTRIC SWITCH OPERATING MEANS; A. W. Bailey, Spokane, Wash. App. filed Aug. 30, 1909. For electric lamps for lighting the entrance to stairways, etc., thrown into circuit by means of a stair tread and opened by treading upon another step of the stairs.

968,561. AUTOMATIC STARTING DEVICE; C. T. Hilderbrandt, Dayton, Ohio. App. filed Sept. 23, 1907. For electric motors for pumps operated when the water reaches a certain level through a hydraulic cylinder and cistern.

968,579. AUTOMATIC SYNCHRONIZER; P. M. MacGahan, Wilkinsburg, Pa. App. filed July 20, 1906. For connecting an alternating-current generator to a circuit when the currents generated agree in phase and frequency with those in the circuit. Improvement on 819,787; the circuits of the actuating windings are arranged so as to dispense with auxiliary transformers and to avoid a direct connection between the generator and the circuit.

968,594. ELECTRICAL APPARATUS; H. T. Olsen, Wilkinsburg, Pa. App. filed Jan. 10, 1908. Interlocking system for use with voltage regulators, including a transformer with a subdivided secondary and an induction regulator giving the total variation of potential equal to the difference of potential between adjacent taps of the secondary winding. Includes a controller drum with ratchets and pawls and magnets for operating them.

968,587. SYSTEM OF POTENTIAL REGULATION; W. M. McConahey, Pittsburgh, Pa. App. filed Jan. 10, 1908. A transformer with a plurality of intermediate taps and an induction regulator associated therewith with a switch and a movable coil for restricting the movement of the switch.

968,603. MEANS FOR REGULATING ELECTRODES IN ELECTRIC FURNACES; J. H. Reid, Newark, N. J. App. filed Jan. 13, 1910. A plurality of electrodes, a power-driven shaft gearing between each electrode and the shaft including a reversible magnetic clutch which is controlled by current passing through the electrode, the gearing giving a continuous drive.

968,622. ELECTROPLATING TANK; E. R. Williams, Streator, Ill. App. filed Feb. 23, 1910. A tank for the plating solution, a pair of rack bars above it and carrying U-shaped handles, the bars being vertically adjustable.

968,631. ELECTRIC MOTOR METER; A. Zipplies, Mosbach, Germany. App. filed June 28, 1909. A magnet with an armature to rotate within the field of the same, a shaft connected with the armature, electrically operated means to effect longitudinal movement of the shaft, a collector connected with the shaft and stationary brushes engaging the collector.

968,646. ANNUNCIATOR; W. W. Dean, Elyria, Ohio. App. filed July 26, 1909. Controlled by an electromagnet with a signal and switch contact controlled by the magnet, the armature moving rectilinearly to close the switch and then rotating to operate the signal.

968,651. PROCESS OF EXTRACTING METALS FROM THEIR ORES; W. E. Greenawalt, Denver, Col. App. filed Dec. 10, 1907. Improvements on prior patents by treating the ore with an acid chlorid solution and then electrolyzing the resulting solution in the cathode compartment while maintaining a solution of sulphur dioxide in the anode compartment.

968,652. PROCESS OF EXTRACTING METALS FROM THEIR ORES; W. E. Greenawalt, Denver, Col. App. filed Jan. 16, 1906. Electrolyzes cuprous chlorid in the presence of ferrous chlorid to precipitate the copper and then applies the regenerated solution to the ore to extract more copper.

968,677. AUTOMATIC GAS FEED FOR VACUUM TUBES; D. McF. Moore, Newark, N. J. App. filed May 8, 1906. Automatically supplies gas to the vacuum so as to maintain the desired tension by means of a valve and vacuum gage.

968,682. ELECTRIC PERCOLATOR; L. F. Parkhurst and H. G. Weeks, Binghamton, N. Y. App. filed Sept. 27, 1909. An electric heater for the base of a coffee percolator.

968,683. ELECTRIC OVEN; L. F. Parkhurst and H. G. Weeks, Binghamton, N. Y. App. filed Sept. 27, 1909. Three separate degrees of temperatures are produced in the oven by means of a switch and electric heating units attached to the pans of the oven.

968,729. ELECTROMAGNETIC DRILL; F. E. Baney, Smelser, Wis. App. filed April 24, 1908. Reciprocating drill including a plurality of motor coils in a casing, the core of plunger having a reduced central portion, a frame between the ends of the coils, shaft in the frame, a rotary current shifter on the shaft which is actuated on the forward and back movement of the core to shift the current from one to the other coil.

968,796. ELECTRIC SAFETY SWITCH; C. D. Platt, Bridgeport, Conn. App. filed March 22, 1910. Double brake knife switch immersed in oil. Details.

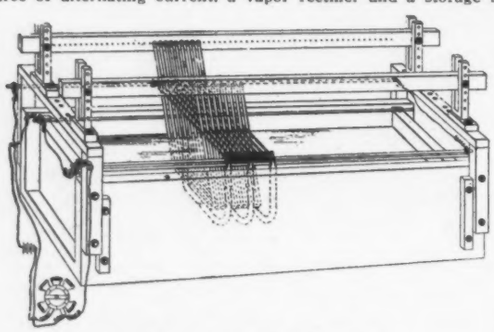
968,821. SEARCHLIGHT, PROJECTOR AND THE LIKE; H. Viertel, Charlottenburg, Germany. App. filed May 25, 1907. A carbon tube surrounds the smaller negative electrode of an arc lamp and carries a portion of the current, together with means for rotating the negative electrode.

968,845. PROCESS OF EXTRACTING METALS FROM THEIR ORES; W. E. Greenawalt, Denver, Col. App. filed April 20, 1905. Electrolyzes cuprous chlorid in the presence of sulphur dioxide and a metal chlorid other than copper chlorid.

968,876. TROLLEY WHEEL; P. F. Morrissy, N. Wise and W. A. Byrne, Auburn, N. Y. App. filed Oct. 17, 1908. Independent duplicate sections side by side, the circumference of each section being formed to provide duplicate wire engaging surfaces.

968,895. DEVICE FOR STEADYING RECTIFIED CURRENTS; P. H. Thomas, Montclair, N. J. App. filed Sept. 27, 1905. A vapor converter and a choke coil with a resistance in series with the choke coil and in shunt with the translating device with a second choke coil in the circuit of translation.

968,896. SYSTEM AND METHOD OF ELECTRICAL DISTRIBUTION; P. H. Thomas, Montclair, N. J. App. filed Dec. 8, 1906. A source of alternating current. a vapor rectifier and a storage battery



968,622.—Electroplating Tank.

across the circuit with an inductance in the path of current of the battery and a second storage battery beyond the inductance in parallel with the first battery and of the same voltage.

968,897. SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR LAMPS; P. H. Thomas, Montclair, N. J. App. filed Aug. 20, 1907. A number of vapor devices each having a common electrode and a plurality of positive electrodes with a temporary metallic circuit through each device, a circuit in shunt to the metallic circuit with an interrupter for the metallic circuit in the shunt circuit.

968,938. AUTOMATIC ATTACHMENT FOR CLEANING ROUND CARBON OR METAL LIGHTNING ARRESTERS; W. S. Hale, Buckley, Ill. App. filed April 30, 1909. A lightning arrester having a terminal disk with a receiver hook which operates a lever which rotates a cap to clean the disk.

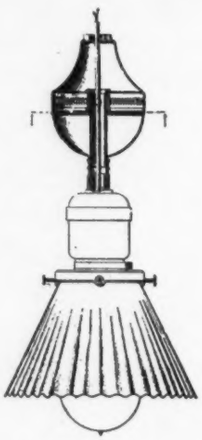
968,949. ELECTRODE AND PROCESS FOR MAKING THE SAME; H. J. J. Jaburg, Jr. App. filed Aug. 30, 1909. Has a body of hard carbon and a supporting edge made of carbon less dense than the body of the electrode and containing a substance which gives off oxygen when heated.

968,950. TERMINAL CONNECTION; E. P. Jahn, Boston, Mass. App. filed May 21, 1910. For terminals of different kinds, the connection including two resilient members with a cylindrical socket, one member projecting beyond the socket and having an aperture and a slot for the terminal.

969,004. SYSTEM OF LIGHTING AND DISTRIBUTION BY VAPOR LAMPS; P. H. Thomas, Montclair, N. J. App. filed Aug. 20, 1907. A number of vapor electric devices in series, each with a negative electrode and a plurality of positive electrodes, and all of the devices connected with constant-potential mains, the several lamps in shunt as to their positive electrodes to two choke coils with a common point connected to the negative electrode of each device.

969,007. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 25, 1908. A main generator with a main distribution circuit, a battery and booster and a transformer with the primary in the main circuit and the secondary in series with the battery.

969,008. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 25, 1908. A main generator, a circuit connected thereto, a storage device and a booster connected



968,787—Lamp Fixture.

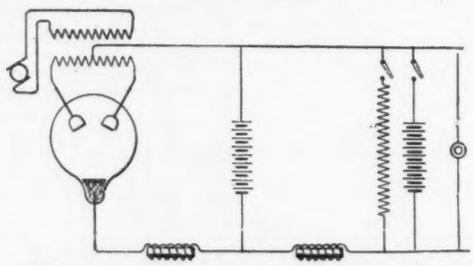
to the circuit with a transformer in the circuit, the secondary being connected with the booster armature for regulating it.

969,013. BATHING APPARATUS; G. W. Walters, Findlay, Ohio. App. filed June 11, 1909. The water tank carries an induction coil with vibrator and one electrode is in the form of a brush connected to a battery.

969,055. FOOT CONTROLLER FOR ELECTRIC MOTORS; J. F. Hammond, Prince Bay, N. Y. App. filed Sept. 23, 1908. For dental engines with a controller arm connected to a shaft carrying contacts and operated by a lever, together with two spring-actuated arms projecting in opposite direction and turning independently about the shaft, the arms bearing upon the side of the operating lever.

969,064. PROCESS OF MANUFACTURING ARTICLES WITH THE USE OF COLLOIDS; H. Kuzel, Baden, near Vienna, Austria-Hungary. App. filed March 26, 1907. For making incandescent lamp filaments by preparing a plastic mass of colloid, bringing it into the desired shape, expressing the liquid, drying and heating at a temperature below the melting temperature.

969,095. INTERCOMMUNICATING TELEPHONE SYSTEM; A. Ekstrom, Stockholm, Sweden. App. filed July 15, 1905. A plurality of interconnected stations with a transmitter and receiver and relay at each station, a source of signaling current in circuit with the relay for energizing the relay at the calling station so as to break the local



968,896—System and Method of Electrical Distribution.

circuit and place the telephone of the calling station in circuit with that of the called station.

969,109. SOLDER FOR INCANDESCENT-LAMP FILAMENTS; H. Kuzel, Baden, near Vienna, Austria-Hungary. App. filed Nov. 20, 1906. Carbid of aluminum to which a substance is added, such as manganese, which raises the melting temperature of the composition.

969,114. HAIR-DRESSING APPARATUS; C. J. Packard, Providence, R. I. App. filed March 30, 1910. Electric curling iron with a thermometer to give the temperature.

969,115. TRACK RAIL BOND FOR RAILWAYS; C. A. Parker, Fort Fred Steel, Wyoming. App. filed Dec. 21, 1909. A contact plate secured to the track rail web and a contact tin projecting from an adjacent fish-plate and pressing upon the free end of the contact plate.

969,147. FOOT-WARMING ATTACHMENT FOR ELECTROTHERMAL GARMENTS; B. R. Charles, Portland, Ore. App. filed Aug. 7, 1909. For therapeutic purposes in which a slipper-like attachment electrically heated is connected to an electrically heated garment.